



RADIATION SAFETY MANUAL

FOR
UNIVERSITY OF ARKANSAS FOR MEDICAL SCIENCES
LITTLE ROCK, ARKANSAS
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UNIVERSITY OF ARKANSAS
FOR MEDICAL SCIENCES

THE UNIVERSITY OF ARKANSAS FOR MEDICAL SCIENCE
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RADIATION SAFETY COMMITTEE
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Emergency Assistance

In case of an emergency or accident situation:

Notify: Occupational Health & Safety

Radiation Safety

501-686-7803 or 501-686-5536

Nights, Weekends or Holidays: Notify Campus Operations Call Center
501-526-0000

Additional emergency information is available from:

A. Section 10.0 of this manual

B. The Chemical Hygiene Plan in the UAMS Safety manual

For routine contact with the Radiation Safety Office

Occupational Health & Safety: 501-686-5536

Central Building, G-154

Introduction

The objective of the University of Arkansas for Medical Sciences (UAMS) Radiation Safety Program is to assist all levels of management in fulfilling the UAMS commitment to furnish a place of employment and learning which is as free as possible from recognized radiation hazards that cause or are likely to cause harm or death to personnel and/or the surrounding community. It is vital that faculty, staff, and students have sufficient information available to aid them in the safe conduct of their day to day work activities while working with radioactive materials and/or devices.

The Arkansas Department of Health issues a broad scope license to the UAMS, which authorizes the use of radionuclides and radiation producing machines or devices. An essential component of that license is this Radiation Safety Manual.

The purpose of the UAMS Radiation Safety Manual is to assist both personnel and management in complying with the objectives of the Arkansas Department of Health, Radiation Control regulations and the UAMS Radiation Safety Committee. This Manual is not intended to be an exhaustive or fully comprehensive reference, but rather a guide for authorized users or other technically qualified individuals. Further information or advice concerning hazards associated with radioactive materials or ionizing producing equipment should be obtained through consultation with the Radiation Safety Committee, the Radiation Safety Officer or Department of Occupational Health & Safety.

1.0 RADIATION SAFETY COMMITTEE (RSC)

1.1 THE PURPOSE OF THE RADIATION SAFETY COMMITTEE

The establishment of a Radiation Safety Committee (RSC) is required by Arkansas Health Department regulations. This was established with the passage of Act 8 of Second Extraordinary Session of 1961, and became effective May 3, 1966 with the approval of and in agreement with the U. S. Atomic Energy Commission (now known as the Nuclear Regulatory Commission, NRC).

The purpose of the RSC is to promote the best practice in safe handling and use of radiation sources. The RSC is also established to assure compliance with State regulations and the conditions set forth by the license. The license held by the University of Arkansas for Medical Sciences is a broad scope medical license and includes all radionuclides from atomic number 1 through 83. One license is held by the entire University, and any individual or action which jeopardizes the license endangers the permission of all researchers to utilize radioactive materials at UAMS.

This RSC's services are available to all users, Department Heads, and the Administrative Officials of the Hospital and University.

1.2 ORGANIZATION OF THE RADIATION SAFETY COMMITTEE

The Radiation Safety Committee is one of six subcommittees of the University of Arkansas for Medical Sciences (UAMS) Safety Coordinating Committee. The UAMS Safety Coordinating Committee is composed of the Chairmen of the subcommittees plus other staff and community members. The RSC consists of at least three members appointed by the Chancellor. The membership includes physicians expert in nuclear medicine, internal medicine and either Hematology or Pathology, therapeutic radiology, representatives of institutional management and the nursing staff, and a person with special competence in radiation safety.

1.3 RADIATION SAFETY COMMITTEE RESPONSIBILITIES

1. To review and grant permission for, or disapprove, the use of sources of ionizing radiation used within this institution from the standpoint of radiological health and safety of patients, working personnel and other factors which the Committee may wish to establish.
2. Prescribe special conditions that will be required during a proposed use of radioactive material such as requirements for bioassays, and physical examinations of users, minimum level of training and experience of users.
3. Receive and review records and reports from the RSO or other individuals delegated responsible for radiation safety practices in this institution.
4. Review and approve all changes to procedures related to the Radiation Safety Program prior to implementation and ensure that the procedures satisfy regulatory requirements, do not change existing license conditions, and do not decrease the effectiveness of the Radiation Safety Program.
5. Implementation of program and procedural changes.
6. Take appropriate actions when noncompliance is identified, including analysis of the cause, corrective actions, and actions to prevent recurrence.
7. Formulate and review the institutional training programs for the safe use of radioisotopes.

8. Monitoring the Institutional program to maintain occupational doses as low as reasonably achievable (ALARA).
9. Inform Arkansas Department of Health, Radiation Control Program (ADH) of any changes in committee membership.
10. Ensure that the Radiation Safety Manual and license are amended as required by Arkansas regulations and approve any changes in the Radiation Safety Manual.
11. Maintain written record of actions taken by the Committee.

1.4 RADIATION SAFETY COMMITTEE MEETINGS

The RSC shall meet quarterly, upon due notice by the RSO, who shall advise the Committee members of the time and place of the meetings. The proceedings of each meeting shall be recorded, published and circulated to Committee members, and may be made available to interested persons upon request.

1.5 SAFETY VIOLATIONS

Investigation of safety violations can be initiated by the Committee or the RSO (see section 2.3). The Committee may request the RSO to make special investigations of any facilities where radiation sources are used. Promptly, upon completion, a report of the investigation shall be submitted to the RSC for review and appropriate action.

After consideration of the violation report, the Committee may:

1. Make a recommendation for mandatory remedial action. Failure to comply with Committee remedial action may result in withdrawal of the Committee's approval of the user's radioactive material authorization, or
2. Revoke the authorization forthwith, if in the Committee's opinion, the violation endangers the health or safety of persons or property. In the event the RSC withdraws its approval, the project shall no longer be carried out within UAMS until a new authorization application has been submitted, reviewed and approved.

1.6 ENFORCEMENT POLICY

The Radiation Safety Office is required to conduct a minimum of an annual review of the laboratory activities performed by authorized users of radioactive material. The actual number of audits an authorized user receives in a year can vary according to the volume and use of radioactive materials.

During the audit, items listed in the radiation safety manual are evaluated to determine the user's compliance with the regulations. The following items are evaluated:

1. Performs and documents contamination surveys as required by use.
2. Maintains a current inventory of all radioactive materials in the possession of the authorized user.

3. Records use and disposal of all radioactive materials.
4. Provides proper storage and labeling of radioactive material.
5. Ensures adequate security (Locks laboratory doors when lab is not occupied).
6. Maintains acceptable radiation and contamination levels in the laboratory.
7. Ensures proper posting of signs and notices in the laboratory.
8. Prohibits smoking and the use of food or drink in the laboratory.
9. Radioactive waste is maintained according to procedures outlined in the Radiation Safety Manual.
10. Ensures all personnel comply with the recommendations to wear personnel monitoring badges or other forms of radiation dosimeters.

At the completion of the laboratory audit, a letter is sent to the authorized user stating the results. If infractions or items of noncompliance are noted during the audit, each item is outlined for the authorized user with recommendations for compliance.

When items of noncompliance are present, the authorized user must submit a written response outlining the new procedures to ensure future compliance. This response must be received by the Radiation Safety Office within **30 calendar days** of the audit. Failure to comply with the 30 day time period may result in the **loss of user privileges**, i.e., no radioactive material can be purchased, used, or received until compliance with all rules and regulations is documented.

Follow-up audits will be used to evaluate efforts to correct any items of noncompliance. If items of noncompliance are not corrected and are noted on follow-up audits, **user privileges will be revoked until the authorized user addresses each infraction**. The Radiation Safety Committee will evaluate the efforts and results of the authorized user in correcting items of noncompliance.

*** An exception to this rule is the presence of food and drink in the lab. In the event food and drink is found in the lab it could result in an immediate one-week suspension of all radioactive material use.**

* Effective October 1, 2007, a three-phase enforcement policy has been implemented for violation of the radioactive material security requirement. For the first violation, the standard notice of violation with required 30-day response will apply. For the second violation within 12-months, lab staff and the authorized researcher must attend a security training briefing presented by Radiation Safety Office staff with written documentation of security training. For the third violation within 12-months there will be an immediate one-week suspension of all radioactive material use. NOTE: The security requirement and enforcement policy also applies to Common Rooms used for storage of radioactive materials and radioactive waste.

SUMMARY OF ACTIONS:

1. Audit with infractions - letter to authorized user.
2. 30 days to submit written documentation outlining methods to ensure future compliance.
3. Follow-up audit to assess correction of infractions.
4. Failure to comply with the rules and regulations set forth by the Arkansas Department of Health, UAMS Radiation Safety Committee, Radiation Safety Office and the Radiation Safety Manual will result in the loss of user privileges.

2.0 THE RADIATION SAFETY OFFICER (RSO)

2.1 THE AUTHORITY OF THE RSO

The RSO derives authority from the Chancellor of the Medical Sciences Campus. In the absence of the Chairman of the Radiation Safety Committee, the RSO is the authorized representative of the Radiation Safety Committee regarding measures to implement radiation protection and control within the University of Arkansas for Medical Sciences.

2.2 ORGANIZATION

The RSO is assisted by the Radiation Safety Coordinator and other members of Occupational Health and Safety (OH&S).

2.3 RESPONSIBILITIES OF THE RADIATION SAFETY OFFICER

The duties and responsibilities of the RSO include:

1. Stop unsafe activities involving radioactive materials or sources of radiation
2. Provide consulting services on all aspects of radiation protection,
3. Maintain radiation doses, releases, contamination and other risks as low as reasonably achievable (ALARA),
4. Develop and maintain a procedure for personnel monitoring, review personnel exposure records, and developing corrective actions for those exposures approaching maximum permissible limits and maintain records of the results of such monitoring
5. Maintain documentation to demonstrate, by measurement or calculation, that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual limit for members of the public;
6. Conduct educational programs for the purpose of instructing employees and students in the proper procedures and the equipment necessary for the safe use of radiation sources,
7. Develop, distribute and implement up-to-date radiation protection procedures in the daily operation of the licensee's radioactive material program
8. Perform a preliminary review of proposed new uses and users, prior to formally discussing the proposal with the RSC
9. Furnish authorized users of radioactive materials a copy of the Radiation Safety Manual and inform them of relevant sections of the State regulations as well as periodic changes of same
10. Establish and maintain procedures for the safe disposal of radioactive materials,
11. Conduct quarterly inventory and six month leak testing of sealed radioactive sources,
12. Inspect all facilities and equipment for appropriate radiation safety procedures and features
13. Oversee the ordering, receipt, surveys, and delivery of radioactive material
14. Ensure that radioactive material is transported, or offered for transport, in accordance with all applicable DOT requirements
15. Ensure that possession, use, and storage of radioactive material is consistent with the limitations in the license, the regulations, the Sealed Source Device Registry (SSDR) Certificate, and the manufacturer's recommendations and instructions;

16. Ensure that individuals installing, relocating, maintaining, adjusting, or repairing devices containing sealed sources are trained and authorized by Arkansas Department of Health, NRC or Agreement State radioactive material license;
17. Investigate any incidents and respond to any emergencies
18. Notify proper authorities of incidents such as loss or theft of radioactive material, damage to or malfunction of sealed sources, and fire;
19. Investigate and report to the Arkansas Department of Health, medical events and precursor events, identify the cause(s) and appropriate corrective action(s) and take timely corrective action(s)
20. Audit the radiation protection program at least annually
21. Maintain appropriate records
22. Maintain an up-to-date license, submit amendment and renewal requests in a timely manner.

3.0 LICENSING AND REGISTRATION REGULATIONS

3.1 FEDERAL REGULATIONS

There are several areas in which the Federal Government retains regulatory powers in agreement states such as Arkansas.

- 1) The receipt, possession, use or transfer of by-product, source, or special nuclear materials in quantities sufficient to form a critical mass.
- 2) The construction and operation of any production or utilization facility.
- 3) The export from or import into the United States of by-product, source, special nuclear material, or electronic devices.
- 4) Any agency of the Federal Government.

In all other cases the delegated authority within the agreement state is given the power to license and regulate the receipt, possession, use and transfer of sources of ionizing radiation.

3.2 STATE REGULATIONS

As an agreement state, the Radiation Control Program of the Arkansas Department of Health is empowered to license sources of radiation and to enforce the regulations governing the activities of a licensee or registrant. The University of Arkansas for Medical Sciences has been issued a license by this agency covering a broad spectrum of uses. The regulations adapted for Arkansas cover by-product, source, and special nuclear material as well as natural and accelerator products, and machines designed to emit ionizing radiation such as x-ray machines.

A current copy of the ASBH Rules and Regulations for Control of Sources of Ionizing Radiation can be reviewed in the Radiation Safety Office. Copies of these regulations can be viewed on the ADH website www.healthy.arkansas.gov.

3.3 UNIVERSITY OF ARKANSAS FOR MEDICAL SCIENCES CAMPUS REGULATIONS

No person may use or transfer into the University of Arkansas for Medical Sciences any radioactive materials without prior written approval by the Radiation Safety Committee. Exceptions may be made for the short-term use of low level or sealed sources for non-medical purposes, e.g., instructional demonstrations, after prior consultation with the RSO.

All statements related to procurement, use and disposal of radioactive materials appearing in this booklet will be considered as the University of Arkansas for Medical Sciences regulations as well as specific directives given in individual permits relating to these or other sources of radiation.

A copy of the radioactive material license and inspection reports can be found in the Occupational Health and Safety Office (OH&S), Central Building, G-154.

3.4 RESPONSIBILITY OF APPROVED USERS

Those persons who are permitted by the Radiation Safety Committee to use radioactive materials under the UAMS license are responsible for the safe use of radiation sources by individuals under their control. The authorized user is responsible for:

1. Compliance with the UAMS rules and regulations for radiation safety and the state “Rules and Regulations for the Control of Sources of Ionizing Radiation.”
2. Instruction of employees under their control in the use of safety devices and procedures. Ensuring **all** radiation workers complete a radiation safety orientation prior to working with radioisotopes.
3. Adequate planning of an experiment, or procedure, to assure that appropriate safety precautions are taken.
4. Notifying OH&S of any personnel changes, including addition or termination of employees, or changes in operational procedures, new techniques, or changes of areas where radioactive materials may be used or stored.
5. Direction of personnel under their control to comply with all recommendations to wear personnel monitoring badges, to survey their hands and clothing, to submit to bioassay, etc., which are designed to control and to reduce their total exposure.
6. Limiting the use of radioisotopes under the permit to those over whom he has supervisory control.
7. Maintaining required current records of receipt, use, storage, and disposal of radioisotopes.
8. Preparing a quarterly inventory of radioactive materials on hand and at other times when requested by the RSO.
9. Segregating, containing, and labeling of all radioactive waste in accordance with the guidelines of OH&S.
10. Cleanup of contaminated equipment or areas is the responsibility of the authorized user and the persons creating the contamination. It may not be assigned or delegated to staff outside the laboratory, such as housekeeping or maintenance workers.
11. Promptly notifying the Radiation Safety Office of any accidents or incidents.

3.5 RESPONSIBILITY OF THE INDIVIDUAL USER OF RADIOISOTOPES

One of the basic tenets of safety is that all individuals must take responsibility for their own safety, and ensure that any actions taken do not constitute a hazard to others or to the environment. Each person at UAMS who has any contact with sources of ionizing radiation has a responsibility to:

1. Keep their exposure to radiation at the lowest practical value and specifically below the maximum permissible exposure as stated in Section 6.2.2.
2. Wear the recommended radiation detectors for personnel, such as personnel monitoring badges.
3. Survey hands, shoes, body and clothing for radioactivity and remove all loose contamination **before** leaving the laboratory.

4. Use all recommended protective measures such as protective clothing, respiratory protection, remote pipetting devices, ventilated and shielded glove boxes and hoods.
5. No smoking, eating, drinking, chewing gum or application of make-up is permitted in radioisotope laboratories. No food item shall be stored in a radioactive material use or storage area. (If evidence of food or drink is found during a lab audit it will result in an immediate one-week suspension of all radioactive material use.
6. Maintain clean working habits. Work surfaces should be covered with plastic backed absorbent paper, plastic side down. Where practical, an impervious tray or pan should be used under the paper in order to ensure containment of spills.
7. Check working areas for contamination periodically or after each radioisotope procedure in conformity with Section 6.5.
8. Maintain good housekeeping practices in the laboratories.
9. Label radiation equipment and segregate radiation waste and equipment to avoid cross contamination.
10. Report immediately to the RSO the details of a spill or other accidents involving radioactivity. 501-686-7803.
11. Conduct decontamination procedures. (See 10.2, Emergency Procedures)
12. Workers must practice ALARA (As Low As Reasonably Achievable) in their work, and minimize the potential for exposures, contamination or release of radioactive materials.
13. Workers are responsible for maintaining security of radioactive materials. (See section on Security of Radioactive Materials, Section 5.6).

4.0 PROCEDURE FOR OBTAINING APPROVAL TO USE RADIOISOTOPES

The Radiation Safety Committee has obtained in the name of the University of Arkansas for Medical Sciences a broad scope license from the Arkansas State Board of Health for the use of radioactive materials. The Radiation Safety Committee is empowered to approve internal permits for responsible and qualified individuals to use radioactive materials within the University of Arkansas Medical Sciences.

The permits are approved for the purchase, transfer, use, and disposal of specific amounts of a particular nuclide within the educational, hospital and research facilities of the University of Arkansas for Medical Sciences.

The Committee requires the completion and approval of the following application forms before permission can be granted. An application is included in Appendix V.

4.1 APPLICATION FOR RADIOISOTOPE APPROVAL

Each individual planning to use radiation sources must demonstrate to the Committee adequate training in, and facility for, the safe use of these materials. The following requirements have been adopted in the issuance of permits for non-human use (biological, chemical, or physical.)

1. The applicant must have a minimum of 20 hours training and a working knowledge of basic radioisotope handling techniques. Topics of training should include: Principles and practices of radiation safety, radiation measurement, monitoring techniques and instruments, mathematics and calculations basic to use and measurement of radiation, and biological effects of radiation.
2. The applicant is to obtain from the RSO (501-686-7803) UAMS application forms (see Appendix V).
3. The applicant is to send to the RSO completed copies of these forms. After initial review by the Chairman and RSO, copies of the application along with a ballot will be sent to each Committee member for their independent consideration and approval or disapproval. Please allow two to three weeks for approval.
4. The applicant is granted approval by a two-thirds vote by the Committee membership. However, reasonable effort is to be made to answer dissenting questions and/or clarifications.
5. Upon approval, the RSO will provide the applicant with a letter of approval. This letter may contain special conditions and/or restrictions relative to the planned activities.
6. The RSO will periodically review the status of a user, use, or work in progress for the purpose of updating the "users list" so that it provides an accurate summary of the work being conducted. Applications are to be submitted at any time there is a change affecting possession limits, disposal methods or amounts, or any change which might result in changes in radiation dose to personnel, patients, or general public. Authorized users will resubmit their applications every three years for review and re-approval.
7. The review of radioactive material use applications will include an evaluation of the adequacy of the proposed facilities. Areas considered in the evaluation may include:

- a. availability of radiation detection instruments
 - b. adequacy of ventilation and fume hoods
 - 1) Radioactive materials in gaseous form must be used in a fume hood so that materials will be exhausted to the outside with no recirculation. Fume hood face velocity is checked for adequate flow (80-120 ft/min) at least once per year. Radioactive iodine use must occur in a glove box or other system exhausted through a charcoal filter.
 - c. appropriate work surfaces and floors (non-porous)
 - d. provisions for shielding and secure storage of sources
8. Radioactive materials designated laboratories may only be allowed to remain inactive for 24 months. If radioactive material has not been used in a laboratory within the previous 24 months, the Radiation Safety Office will survey the laboratory to ensure that it is contamination free and all radioactive materials posting will be removed. The laboratory will no longer be approved for radioactive material use or storage.
 9. The status of authorized users, who have not used radioactive material within the past 24 months and who do not have radioactive material in storage, may be changed from active to inactive.

4.2 APPLICATION FOR RADIOISOTOPE APPROVAL FOR HUMAN USE

The general requirements for a permit to administer radioactive materials to humans for purposes of routine diagnosis or treatment are more restrictive than those for non-human use. The prerequisites are:

1. The user must be a physician licensed in Arkansas to dispense drugs in the practice of medicine.
2. The physician must have basic radioisotope training and for certain common procedures must have participated actively in the human use of radioisotopes (for details see Appendix II).

Any person applying for experimental medical use of radionuclides or x-rays shall submit:

1. Approval request to the Institutional Review Board (Human Research Advisor Committee).
2. A research protocol, which includes the information as, outlined in Appendix II.

5.0 PROCUREMENT OF RADIOACTIVE MATERIALS

5.1 PURCHASES

Purchase orders for radioactive materials must have the approval of OH&S **before** the Purchasing Department (UAMS Policy 11.4.09) can process them. Orders must be processed through the on-line ordering system. The purchase order shall indicate the radioisotope, chemical form, total activity in Becquerels, millicuries or microcuries, the name of the approved user authorizing the order, vendor, and delivery address of OH&S, Central Building, G-154.

5.2 RECEIPT AND STORAGE

During “normal” working hours, the delivery vendor (Federal Express) delivers all radioactive materials to the OH&S office. Here they are surveyed, swiped, unpacked and checked for shipping damage, logged-in, inventory/disposal forms prepared, and stored until delivery to the authorized user.

There is no approved afterhours delivery of sealed sources or research isotopes. The only approved afterhours deliveries are to the Nuclear Medicine or PET Departments. When afterhours deliveries are made to these departments, Nuclear Medicine Technologists are present to receive the material or material is placed in a secure location in the Nuclear Medicine Department.

The OH&S office must be contacted when special attention or special arrangements are required.

5.3 MATERIAL TRANSFERRED TO THE UAMS BY AN INDIVIDUAL

Purchases made under an individual license or another institutional license and transferred to the UAMS shall have **prior** approval by the RSO. The person who is to receive this material must have the Radiation Safety Committee approval for the specific isotope and his receipt of it must not result in exceeding his or the University of Arkansas for Medical Sciences possession limit.

5.4 TRANSFER OF MATERIALS FROM ONE USER TO ANOTHER WITHIN THE UNIVERSITY OF ARKANSAS FOR MEDICAL SCIENCES CAMPUS

Transfer of radioactive material between investigators of different projects must be reported prior to the transfer by contacting the OH&S office. These transfers must be between committee approved principal investigators, and within the limits of the approved quantities. The transfer should not take place until the authorization to do so has been given by the OH&S office.

Any authorized radioisotope user leaving the jurisdiction of the University of Arkansas for Medical Sciences must make arrangements with the RSO to dispose of or transfer the radioactive material to another authorized user.

5.5 TRANSFER OF MATERIALS FROM AUTHORIZED USERS TO INDIVIDUALS OUTSIDE THE UNIVERSITY OF ARKANSAS FOR MEDICAL SCIENCES CAMPUS

All radioactive material must enter and exit the campus through the Radiation Safety Office/OH&S. Any investigator who wishes to transfer radioactive material to an off-site investigator **must** contact the Radiation Safety Office before the transfer is to take place. The Radiation Safety Office must ensure that all federal and state regulations are followed. The following information must be provided before the transfer is to take place:

1. Name of institution receiving radioactive material.
2. Name of Radiation Safety Officer at receiving institution.
3. Name of investigator receiving radioactive material.
4. Isotope, chemical compounds, and amount of activity.
5. Confirmation must be given to the RSO that the facility is licensed to receive radioactive material. A copy of the institution's radioactive material license is required.
6. The Radiation Safety Office will prepare the package for shipping.

5.6 SECURITY AND STORAGE OF RADIOISOTOPES:

SECURITY:

The Arkansas Department of Health rules and regulations require that security of radioactive materials must be in place at all times. Violations of this regulation are frequently cited at institutions utilizing radioactive materials, and place the license to use such materials in jeopardy. Section RH-1308, of the state Rules and Regulations reads:

(a) The licensee shall control and maintain constant surveillance of licensed material that is in a controlled or unrestricted area and that is not in storage.

This means that in all locations where radioactive materials are present the trained user must be in constant attendance. Otherwise the lab must be locked or secured to prevent unauthorized removal or tampering. If the laboratory is unoccupied: **LOCK THE DOORS.**

STORAGE:

Storage of radioactive materials shall be in secured or locked cabinets, refrigerators, freezers or waste areas, unless attended by the licensee. Radioactive materials shall be stored in sealed containers in such a way as to prevent accidental spillage or breakage, and to prevent release into the air. If the nuclide requires shielding, it shall be stored in shielded containers in order to prevent doses to personnel accessing the storage areas.

If the radioactive material has been stored in a freezer or ultra freezer, it is recommended that the material be thawed, opened and handled in a certified fume hood or biological safety cabinet. Aerosols from stored radioactive materials may cause contamination of adjacent areas and doses to personnel if not handled in the proper way after storage. All radioactive materials, whether in storage, waste or use, must be labeled with the radioactive warning symbol, and the words “Caution, Radioactive Materials”.

6.0 RULES FOR THE SAFE HANDLING OF RADIOACTIVE MATERIALS

6.1 CLASSIFICATION OF AREAS

All rooms or areas in which licensed quantities of radioactive materials are used or stored must be posted with a “Caution Radioactive Material” sign and a “Notice to Employees”. Signs can be obtained from the OH&S office.

6.1.1 UNRESTRICTED AREAS

Any area to which access is not controlled by the licensee or registrant for the purposes of protection of individuals from exposure to radiation and radioactive materials and any area used for residential quarters. An area is unrestricted and does not require control measures:

- 1) if an individual continually present in the area cannot receive more than two mrem (0.02 mSv) in any one hour to any portion of the body; or
- 2) if, when allowance is made for expected occupancy and time variations in dose-rate, no individual is likely to receive more than 100 mrem (1 mSv) in a calendar year.

6.1.2 RESTRICTED AREAS

All areas within the University of Arkansas for Medical Sciences in which dose levels do not conform to the standard for unrestricted areas shall be restricted and under the control of the RSO for radiation safety purposes. The approved user responsible for work with radioisotopes in that area shall be responsible for controlling access to the area. Both Federal and State regulations define restricted areas containing radiation requiring special control measures as follows:

- 1) Radiation Area - Any area accessible to individuals in which there exists ionizing radiation at such levels that a major portion of the body of such individuals could receive an absorbed dose greater than 5 mrem (0.05 mSv) in any one hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates. A sign bearing the radiation symbol and the words “Caution Radiation Area” is to be posted at the entrance.
- 2) High Radiation Area - Any area accessible to individuals in which there exists ionizing radiation at such levels that a major portion of the body could receive in any one hour an absorbed dose greater than 100 mrem (1 mSv). A sign bearing the radiation symbol and the words “Caution High Radiation” is to be posted at the entrance.
- 3) Very High Radiation Area - Any area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads * (5 gray) in one hour at one meter from the radiation source or from any surface that the radiation penetrates.

* The exposure rates for Very High Radiation Areas are in rads, rather than rems, because potentially life-threatening exposures could result in areas with these fluxes of radiation.

Within the restricted area, strict surveillance should be maintained to assure that significant exposure levels are not present, whether in the form of contamination, airborne levels of radiation or external exposure levels. In accordance with the ALARA principle, unrestricted area limits for contamination; exposures and/or releases are to be adhered to at all time, rather than restricted area limits.

6.2 RADIATION DOSE LIMITS

6.2.1 ALARA

ALARA is an acronym meaning As Low As Reasonably Achievable. It is a requirement for all facilities possessing radioactive materials licenses to have a formal ALARA program. The radiation protection standards set forth in this manual are used to control radiation exposure to all personnel occupationally exposed to radiation. It is the policy of the University of Arkansas for Medical Sciences to keep this exposure as low as reasonably achievable (ALARA).

The University has established an “Investigational level” for any individual who receives a monthly whole body effective dose of 100 mRem or greater. A questionnaire is sent to the individual seeking information on duties and task performed. The RSO will review the questionnaire and evaluate the procedures and duties following completion of the investigations. The exception to the 100 mRem investigational limit is for the individuals who perform interventional fluoroscopic procedures. These jobs will routinely expose the individual to greater than 100 mRem in a given month when work load is heavy. The 300 mRem investigational limit will apply to these job duties.

It is not a violation of the law to exceed an ALARA guideline; however, these occurrences alert radiation safety staff and radioactive materials users to situations which need to be reviewed to determine whether the practices may be modified to better reflect ALARA management practices.

6.2.2 OCCUPATIONAL DOSE LIMITS

No individual may receive in one calendar year a total occupational exposure in excess of the following:

<u>Part of Body</u>	<u>Adult / Yearly</u>
Whole body- head and trunk; gonads; arms above elbow, legs above the knee; active blood forming organs (TEDE)	5,000 mrem or 50 mSv
Extremities- hands and forearms; feet and ankles, leg below the knee (SDE)	50,000 mrem or 500 mSv
Lens of eyes (LDE)	15,000 mrem or 150 mSv
Single organ dose (TODE)	50,000 mrem or 500 mSv
Skin of whole body (SDE)	50,000 mrem or 500 mSv

DE- Dose Equivalent. The product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and Sievert.

CDE- Committed Dose Equivalent. The dose equivalent to organs or tissues of reference that will be received from an intake of radioactive materials by an individual during the 50-year period following the intake.

EDE- Effective Dose Equivalent. It is the sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated.

CEDE- Committed Effective Dose Equivalent. The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues.

DDE- Deep Dose Equivalent. Applies to external whole-body exposure. It is the dose equivalent at a tissue depth of 1 centimeter (1000 mg/cm²)

TEDE- Total Effective Dose Equivalent. The sum of the deep dose equivalent (for external exposures) and the committed dose equivalent (for internal exposures).

SDE- Shallow Dose Equivalent. Applies to the external exposure of the skin or an extremity, is taken as the dose equivalent at a tissue depth of 0.007 centimeter.

LDE- Lens of Eye Dose Equivalent. Applies to the external exposure of the lens and is taken as the dose equivalent at tissue depth of 0.3 centimeter.

TODE- Total Organ Dose Equivalent. The sum of the CDE and DDE for the maximally exposed organ.

6.2.3 MINORS WORKING WITH RADIOACTIVE MATERIALS

The maximum whole body exposure to minors, (individuals under the age of 18) must be limited to 10% of the permissible limits for adults. For these workers, safety training must be completed prior to work with radioactive materials as with other occupational workers.

6.2.4 EXPOSURE LIMITS FOR THE GENERAL PUBLIC

Any person, who is not regularly employed in using radioactive materials or radiation producing devices, must not receive a radiation dose in excess of either:

- A. 100 mrem (1 mSv) in any one year.
- B. Two mrem (0.02 mSv) in any one hour.

6.2.5 PREGNANT RADIATION WORKERS

The UAMS policy, “Pregnant Employees Working with Ionizing Radiation,” incorporates safety information and radiation dose guidelines for ensuring safe radiation limits for the embryo/fetus of occupationally exposed employees. A copy of the policy is in Appendix VII. Should a pregnant radiation worker wish to notify the Radiation Safety Office, it must be in writing as soon as possible after learning of their pregnancy.

The regulatory dose limit to the embryo/fetus of a declared pregnant worker is 500 mrem (5 mSv) per gestation period. It is further recommended that the monthly exposure should not exceed 50 millirem.

6.3 PERSONNEL MONITORING

Personnel monitoring is required where:

1. An individual receives or is likely to receive in one year from sources external to the body, a dose of 10 percent of the applicable limits (Section 6.2.2).
2. An individual enters a high or very high radiation area.
3. An individual is likely to receive, in one year, an intake in excess of 10 percent of the applicable annual limit on intake (ALI) found in Table 1, Columns 1 and 2 of Appendix G to RH-1000 through RH-2110, Arkansas Rules and Regulations).
4. A minor or declared pregnant woman is likely to receive, in one year, a committed effective dose equivalent in excess of 0.05 rem (0.5 mSv).

6.3.1 WHOLE BODY AND TLD DOSIMETERS

Radiation detection dosimeters (badges) must be worn routinely by personnel when exposure to penetrating radiation is possible. Where the hand dose may exceed 10 percent of the relevant limit

(6.2.2), ring or wrist badges (TLD- thermoluminescent dosimeters) must be worn. Individual workers handling 1 mCi or greater of P³² at a time must wear extremity badges. All individuals responsible for handling of therapeutic sealed sources or administration of therapeutic unsealed doses are provided with extremity monitoring. Where the nature of the radiation or the unusual level of the possible exposure dictates their choice, personnel dosimeters of the ionization type should be worn and readings recorded daily. A guide concerning the advisability of wearing radiation dosimeters is included as Appendix III.

Lost or damaged dosimeters should be reported to the radiation safety office immediately. Replacement dosimeters will be issued. Please contact 501-686-7803 or 501-686-5550 for new dosimeters.

An administrative dose may be determined for an individual when a dosimeter issued by the RSO is lost, damaged, not returned for processing, or records of previous exposures cannot be obtained upon application for dosimetry. The exposure will be evaluated by any of the following methods:

1. Obtaining the individual's work history for the period in question and evaluating an exposure taking into consideration the work performed and past exposure history.
2. Averaging the recorded doses for the three wearing periods prior to and after the period in question whenever possible.
3. Assigning 1.25 rem for each quarter based on an averaging of 5 rem over 12 months for whole body dose equivalents.

6.3.2 BIOASSAYS

Research Staff:

When the RSO considers that significant fractions of the maximum permissible body burden of a given nuclide may be accumulated, the RSO may institute bioassay-assay procedures such as urinalysis or thyroid counting. Individuals routinely handling 100 mCi of tritium, or 10 mCi of C-14, or involved in a spill of this magnitude, shall submit bioassay-assay samples.

Individuals who propose the use of Iodine-125 or Iodine-131 must have a baseline thyroid uptake before iodinations begin. Individuals using one (1) millicurie (3.7×10^7 Bq) or greater of radioiodine in unsealed form should submit to a thyroid uptake within 24-48 hours post iodination. It is the responsibility of the individual user to call and schedule an appointment with OH&S.

Radiopharmaceutical Administration:

If greater than 10 mCi per week of I-131 is administered in volatile form (liquid), a bioassay should be performed within 24-72 hours of dose that exceeded the 10 mCi limit. If less than 10 mCi/week is administered in volatile form (liquid) quarterly bioassays should be performed. Thyroid bioassays are not required when administering Iodine-131 in capsule form.

Thyroid monitoring may be made in the Nuclear Medicine Department using the department's thyroid uptake probe. Results should be maintained for future review. If you suspect that you have received a significant exposure, contact the RSO immediately.

Whenever the thyroid burden at the time of measurement exceeds 0.12 uCi of I-125 or 0.04 uCi of I-131, the following actions will be taken:

- (a) An investigation of the operations will be carried out to determine the causes of exposure and to evaluate the potential for further exposures.
- (b) Corrective actions that will eliminate or lower the potential for further exposures will be implemented.
- (c) A repeat bioassay will be taken within 2 weeks of the previous to confirm the presence of internal radioiodine and to obtain an estimate of its effective half-life for use in estimating dose commitment.
- (d) Notification will be provided in accordance with regulations.

6.4 POSTING OF LABORATORIES, AREAS, AND EQUIPMENT

Signs are required by regulation to denote areas or containers with levels of radiation or radioactivity specified in the following sections.

6.4.1 “CAUTION RADIATION AREA” In areas accessible to personnel in which a major portion of the body could receive in any one hour a dose of 5 mrem. A sign is NOT required on a room containing a sealed source if the radiation level 12 inches from the surface of the source container or housing does not exceed 5 mrem/hour.

6.4.2 “CAUTION RADIOACTIVE MATERIAL” Each laboratory or area where radioactive materials are used or stored must be posted at the entrance with a “CAUTION RADIOACTIVE MATERIALS” sign. Entry and area warning signs are to be posted and removed only by Radiation Safety personnel.

Refrigerators, freezers, and other ‘in lab’ storage areas, and containers in which materials are stored or transported must have a visible label with the radiation caution symbol and the words CAUTION RADIOACTIVE MATERIALS.

6.4.3 Other signs are required for HIGH RADIATION AREAS (dose rate greater than 100 mrem in an hour) with the above exceptions, and in AIRBORNE RADIOACTIVITY AREAS. The RSO must be consulted regarding control measures in these areas.

6.5 SURVEYS

The OH&S will make annual independent surveys (audits) of all active radioisotope laboratories. Many labs will be audited on a more frequent schedule depending on the amount of radioactivity in use. Such things as inventory assessment, contamination control, and waste disposal practices will be addressed during these audits.

Survey (audit) results will be forwarded to the authorized user, and a recheck may be conducted in the event problems have been detected that need corrective action. Section 1.6 of this manual (Enforcement Policy) outlines the procedures to be followed in the event of safety infractions.

Surveys are to be conducted by the authorized user or his/her designee in conjunction with the OH&S surveys. Each lab actively using isotopes must conduct radiation surveys weekly, monthly, or at

time of use, depending on the types and quantities of radioactive materials in use in the laboratory. Removable contamination can be detected and measured through a wipe test of the surface, which is counted in an appropriate counting instrument, such as liquid scintillation counter or gamma counter. Records of these surveys must be maintained for review. Each survey record should include the following:

- a diagram of the area surveyed
- a list of items and equipment surveyed
- specific locations on the survey diagram where wipe test was taken
- ambient radiation levels with appropriate units
- contamination levels with appropriate units
- make and model number of instruments used
- background levels
- name of the person making the evaluation and recording the results and date.

A. Ambient Dose Rate Surveys

1. Radiopharmaceutical preparation and administration areas: survey at the end of each day of use with a radiation detection survey meter.
2. Research Laboratory areas: external radiation levels should be kept less than 0.1 mR/hr at contact with the source surface and to levels as low as reasonably achievable. These surveys do not require documentation.
3. Sealed source and brachytherapy storage areas: survey quarterly with a radiation measurement survey meter. A physical inventory of the sources should be done at least quarterly and when sources are removed and returned to storage. Leak testing of sealed sources is done every 6 months.
4. Ambient dose rate survey action levels are 2.0 mR/hr for unrestricted areas and 5.0 mR/hr for restricted areas.

B. Removable Contamination Surveys

1. Radiopharmaceutical preparation and administration areas, and OH&S receipt and waste processing areas: survey weekly for removable contamination.
2. Research Laboratory areas where only small quantities of radioactive material are processed (less than 200 microcuries at a time), survey monthly for removable contamination. If more than 200 microcuries is in use at any one time, surveys shall be performed weekly.
3. The wipe test procedure should be sufficiently sensitive to detect the presence of 500 DPM per 100 cm² of removable contamination. A radioactive source with a known amount of activity must be used to convert sample measurements (usually in counts per minute or CPM) to disintegrations per minute or DPM.

Wipe tests are performed by wiping the areas of interest with a filter paper disk or cotton tipped applicator and then determining the activity in a counter calibrated for the suspected radionuclide. Wipe tests are more sensitive than instrument surveys.

In keeping with the ALARA concept, any detectable contamination should be cleaned immediately.

6.5.1 CONTAMINATION LEVELS

Removable surface contamination levels for beta or for beta-gamma emitters shall be controlled such that a level of **500 DPM per 100 sq. cm.** is not exceeded. When removable radioactivity is found, the area must be decontaminated and then re-surveyed and documented. Detectable levels of removable contamination should be removed, and non-removable contamination should be labeled and shielded whenever possible in order to maintain ALARA limits.

(Note: Removable surface contamination levels within restricted areas in the Nuclear Medicine and PET Departments shall be controlled such that a level of 2200 DPM per 100 sq cm is not exceeded.)

It is understood that certain areas may be routinely contaminated, such as internal parts of equipment and inside areas of glassware, and that it may not be practical to decontaminate these surfaces after each use. The equipment should be monitored routinely and cleaned periodically. Signs must be posted and protective clothing and gloves should be used when in contact with these areas. In some cases, such as P-32 contaminated equipment, shielding is required.

Radioactive contamination levels of air and water in restricted areas must be controlled such that the levels specified in Section 3, Appendix G, Table I, of the Arkansas Rules and Regulations are not exceeded. In unrestricted areas, contamination levels of air and water shall not exceed those specified in Section 3, Appendix G, Table II.

6.6 HANDLING OF RADIOACTIVE MATERIALS

- 1) Before any work is undertaken with quantities of radioisotopes, which may produce significant external or internal exposure, attention shall be given by the user to precautionary measures including the use of hoods, remote handling equipment, and air monitoring. The RSO shall be consulted for recommendation on initial or unusual operations.
- 2) Work, which may result in contamination of work areas, shall be done over stainless steel trays or trays lined with heavy absorbent paper.
- 3) Personnel working in areas containing radioactive materials shall wash their hands thoroughly, using plenty of soap, before eating, smoking or leaving work. Those working with unsealed sources should monitor hands and shoes upon completing operations.
- 4) Eating, storing, or preparation of food is forbidden in a laboratory or rooms where work with unsealed radioactive sources is taking place or where contamination may exist. **If empty food or food containers are found in the normal trash, this is interpreted as “evidence of consumption” by regulators. There will be an immediate one-week suspension of all radioactive material work.**
- 5) Smoking, application of cosmetics, chewing tobacco and gum are not permitted in areas where work with unsealed radioactive sources is in progress or where contamination may exist. Under no circumstances should cigarettes, cigars or pipes be laid on tables or benches where radioactive work has been or is in progress.
- 6) Pipetting by mouth is not permitted.
- 7) Impervious gloves shall be worn whenever handling radioactive materials. Impervious gloves shall always be worn when handling open vessels containing alpha emitters or Sr-90, or when handling equipment possibly contaminated with these materials. Gloves should be

cleaned, if practicable, before removal or disposal. They should be handled and stored to prevent contamination of the inside surface.

- 8) All individuals handling radioactivity in the laboratory shall wear laboratory coats. In cases where millicurie amounts of activity are being handled and there is a likelihood of spillage and personal contamination, the laboratory coat should be removed before leaving the isotope laboratory and kept in the laboratory. Where contamination is noted during a laboratory survey, or there has been a spill of radioactive material, which may have produced contamination of a person or clothing, both the person and the clothing shall be monitored.

Personal contamination should be removed as soon as possible. Clothing that shows contamination producing surface count-rates on a thin end-window Geiger-Mueller survey meter of less than twice background may be released for normal laundering. Clothing showing higher count-rates shall be stored until the count-rate is less than twice background or disposed of through a commercial disposal company at the discretion of the RSO.

6.7 STORAGE OF RADIOACTIVE MATERIALS

- 1) Radioisotopes requiring a "Radioactive Materials" label must be stored in areas under the control of the user, which may be locked or otherwise secured against unauthorized removal of the material.
- 2) The radioisotopes shall be stored in a container, shielded if necessary, such that the radiation at a distance of one foot from the container does not exceed 100 mrem/hour, i.e., the area may be classified as no more than a Radiation Area.
- 3) Containers must be properly labeled and area signs posted where necessary.
- 4) Suitable precautions shall be taken so that the probability of an explosion in the storage area, which would cause the dispersion of the radioactivity, is very small.

6.8 TRANSPORTATION ON HOSPITAL PREMISES

- 1) Radioisotopes requiring a "Radioactive Materials" label must be enclosed in non-breakable carrying cases or containers, before being transported through corridors or between buildings.
- 2) Containers for the transportation of beta sources requiring a "Radioactive Materials" label must provide shielding thicker than the maximum range of the beta rays.
- 3) Gamma-ray emitters shall be transported in closed containers, shielded if necessary, such that the dose-rate at the surface does not exceed 200 mrem per hour, and the dose-rate at one meter does not exceed 10 mrem per hour. (D.O.T. shipping regulation, 49CFR 173.441(b) (2) (3).)

6.9 RADIOACTIVE WASTE DISPOSAL

All radioactive waste should be transported by the generating department to Occupational Health and Safety in closed or sealed containers. All waste should be transported on carts to minimize potential spills and accidents. Waste will be accepted at Central Building G-172B or Biomed I 167 by appointment only. Call 501-686-5550 to make an appointment. Waste should be in blue bags and be appropriately labeled with a completed radioactive waste tag. All waste should be properly packaged and tagged before transportation to OH&S. Consult the appropriate section below for packaging and handling of specific waste types.

WASTE TAGS

Waste tags should be as complete as possible. The following information is necessary:

- 1) Approved RAM user's name.
- 2) Isotope - Isotopes should not be mixed. Isotopes with a half-life greater than 120 days should never be mixed with those having a half-life of 120 days or less
- 3) Activity - This should be an upper estimate of how much activity is in each container. The unit of activity should be specified.
- 4) Date - date waste is taken to OH&S.
- 5) Does the waste contain any toxic materials? This is very important to insure proper disposal and for the protection of the personnel that must handle the waste.
- 6) Type of Waste - This should indicate what type of waste is inside the bag.
Each type of waste should be placed in a separate bag or bottle.

*Lead or lead lined containers should not be included in the blue bags; these may be brought down separately. Manufacturer vials containing unused activity should not be placed in a blue bag. Because of the higher specific activity in the unused isotope, these are processed separately. Call OH&S (ext. 501-686-5550) if there are any questions about proper packaging or handling of waste.

6.9.1 STORAGE OF WASTE

- 1) Each laboratory must maintain a waste container which must display a radioactive materials label in a prominent position. The use of a blue disposable liner is required in order to maintain the waste can free of contamination.
- 2) Waste should be separated by type (i.e. dry solids, wet material, liquid scintillation vials, animal carcasses, bulk liquids and small liquid vials)
- 3) Waste should also be separated by half-life. Isotopes with half-lives greater than 120 days should not be mixed with isotopes having a half-life shorter than 120 days. Where possible, it is advantageous to separate waste by individual isotopes.
- 4) Radioactive wastes must only be stored in restricted areas where they can be secured against unauthorized removal by housekeeping personnel. Waste should be clearly labeled as radioactive to prevent accidental removal.
- 5) Liquid wastes should be stored in sealed containers (no open beakers), preferably in polyethylene bottles or typical 4-liter glass reagent jugs. Plastic milk jugs or other containers which formerly held food or beverage items are not permitted. There must be no possibility of a chemical reaction during storage that might cause an explosion or cause the release of radioactive gases or vapors.

6.9.2 LIQUID SCINTILLATION VIALS

It is important that all bags of liquid scintillation vials be tagged to indicate the generating user, isotope, and total activity in the bag. The trade name of the cocktails that were used should be indicated. All scintillation cocktail must be classified as biodegradable and environmentally safe. Additional disposal charges will be incurred for chemically hazardous cocktail. Please consult the material safety data sheets for chemical properties of scintillation cocktail. It is advantageous to include the approximate number of liquid scintillation vials and the approximate volume in the vials on the tag. Liquid scintillation vials should be double bagged before transport to prevent leakage.

Liquid scintillation vials with short half-life isotopes (≤ 120 days) are stored at the Department of Occupational Health & Safety's Low Level Radioactive Waste Holding Area for decay through ten half-lives. Upon decay they are surveyed to verify that the waste is at background levels and then incinerated as non-radioactive waste.

Liquid scintillation vials containing C-14, H-3, or I-125 at concentrations below $0.05 \mu\text{Ci}$ per gram of cocktail (0.00005 mCi/gm) are incinerated as deregulated radioactive waste. Liquid scintillation vials containing C-14, H-3 or I-125 in concentrations greater than $0.05 \mu\text{Ci /gm}$ are temporarily stored and shipped out of UAMS by a commercial disposal service.

Liquid scintillation vials containing isotopes with half-lives greater than 120 days (other than C-14 and H-3) are temporarily stored and shipped out of UAMS by a commercial disposal service. Small vials containing liquid should not be placed in a dry solids bag.

6.9.3 LIQUID AND GASEOUS WASTES

Liquid waste should be brought to OH&S for disposal. Liquids should be labeled as organic or aqueous solutions. A waste tag should be completed and attached to EACH liquid container. The exterior of the container should be free of contamination before it is transported from the laboratory.

Bulk liquids should be designated as either aqueous or organic solutions. Liquids with a short half-life (≤ 120 days) will be stored for decay through ten half-lives. Upon decay they are surveyed to verify that the waste is at background levels and then disposed of appropriately, aqueous solutions to the drain, organic solutions to the Hazardous Materials Officer. Small vials containing liquid should **not** be placed in a dry solids bag.

A permit for the use of isotopes may contain limitations on disposal of liquid wastes by sink and of gaseous wastes through hoods. Instructions for record keeping may also be given. Such limitations will be designed to insure conformity with Federal and State regulations. Any laboratory, however, may dispose of radioactive waste into a designated sink if the following conditions are met:

- 1) The sink designated for radioactive waste disposal shall be marked with the radiation symbol and the words "radioactive materials" in such a way that both laboratory personnel and plumbers are made aware of this fact. The pipes beneath the sink should be marked with "Radioactive Materials" tape.
- 2) A record is kept giving the date and upper estimate of the amount of activity discharged for the day. This is accomplished by maintaining and returning the inventory/disposal forms.
- 3) The material is readily soluble or dispersible in water.

- 4) The quantity of material discharged per day into the sink does not exceed the concentration listed in Table 3 of Appendix G to RH-1000 through RH-2101 of the Arkansas Rules and Regulations. (100 uCi per day is allowed)

The above restrictions do not apply to excreta from individuals undergoing nuclear medicine diagnostic or therapy procedures.

6.9.4 SOLID WASTE

Radioactive waste in the form of dry solids and damp material should be brought to the OH&S for processing and disposal. Materials with a short half-life (≤ 120 days) will be stored at the Department of Occupational Health & Safety's Low Level Radioactive Waste Holding Area for decay through ten half-lives. Upon decay they are surveyed to verify that the waste is at background levels and then disposed of as non-radioactive medical waste.

Solids with a long half-life (>120 days) will be temporarily stored and shipped out of UAMS by a commercial disposal service. Small vials containing liquid should not be placed in a dry solids bag.

6.9.5 ANIMAL CARCASSES

Animal carcasses containing isotopes with short half-lives (≤ 120 days) are stored frozen at the Department of Occupational Health & Safety's Low Level Radioactive Waste Holding Area for decay through ten half-lives. Upon decay they are surveyed to verify that the waste is at background levels and then incinerated as non-radioactive waste. All waste for incineration is processed by OH&S staff.

Animal carcasses containing C-14, H-3, or I-125 at concentrations below $0.05 \mu\text{Ci}$ per gram of body weight (0.00005 mCi/gm) are incinerated as deregulated radioactive waste. All waste for incineration is processed by OH&S staff.

Animal carcasses containing C-14, H-3 or I-125 in concentrations greater than $0.05 \mu\text{Ci/gm}$ are temporarily stored and eventually shipped out of UAMS by a commercial disposal service.

Animal carcasses containing isotopes with half-lives greater than 120 days (other than C-14 and H-3) are temporarily stored and shipped out of UAMS by a commercial disposal service.

6.10 TRAINING OF PERSONNEL

It is mandatory that all research staff who work with radiation, including principal investigators, attend a laboratory safety in-service or online education. This in-service covers lab safety when radioactive material is in use. The RSO shall be notified by the user when new laboratory personnel enter the laboratory. Please contact the Radiation Safety Office for the in-service schedule and educational requirements. Annual web-based refresher training will be required. All training will be documented.

Medical staff who are likely to receive an occupational dose in excess of 100 mRem in a year will receive instruction before assuming duties with, or in the vicinity of, radioactive materials during annual refresher training, and whenever there is a significant change in duties, regulations, terms of

the license, or type of radioactive material or therapy device used. Other individuals who work with or in the vicinity of licensed materials but are not likely to receive an occupational dose in excess of 100 mRem in a year may also receive initial and periodic refresher training. All UAMS employees must complete a web-based annual safety training module that includes radiation awareness training.

6.11 SURVEY INSTRUMENTS AND CALIBRATION

To facilitate safe practice in the University, the Radiation Safety Committee requires that an appropriate calibrated survey meter be available in each authorized laboratory area. "Appropriate" in most cases means a thin window Geiger-Mueller type meter (end window or pancake type) that will detect nanocurie quantities of the particular radioisotopes utilized in the laboratory. A "laboratory area" may be one laboratory or a series of laboratory spaces. Labs located on different floors or in different buildings each need their own meters. Authorized "tritium-only or low energy beta" Users will not be required to meet this requirement, since these meters will not detect the low energy beta emissions.

Instruments must be calibrated annually. Calibrations can be performed by the Radiation Safety Office or returned to the manufacturer. A certificate of calibration is required for each instrument. This certificate must be on file in the laboratory for review during regulatory inspections or in the Radiation Safety Office. The Radiation Safety Office should be informed of the purchase of a new instrument or repair and factory calibration of an existing instrument.

Fixed radiation detection instrumentation, such as, liquid scintillation counters and gamma well counters, should be maintained and serviced as suggested by the manufacturer or vendor. The counting efficiency for isotopes in use must be periodically determined and used when converting contamination survey results from counts per minute to disintegrations per minute.

If the instrument contains an internal radioactive standard, the Radiation Safety Office must be notified when such an instrument is obtained, and prior to disposal of the instrument, so that proper inventory and disposition of the standard can be assured.

6.12 REMOVAL OR TRANSFER OF LABORATORY EQUIPMENT

Any equipment in the laboratory which could have been contaminated with radioactive material must be surveyed before removal to another laboratory, transfer to a repair shop, or transfer to Surplus Property (UAMS Policy MM.2.03 or Administrative policy 11.4.22). Before the equipment is transferred and following satisfactory survey, the Radiation Safety Office will remove all warning signs and stickers. Transfers to Surplus Property must be cleared by the Radiation Safety Office.

6.13 VACATING LABORATORY SPACES

The Radiation Safety Office must be informed of all changes in authorized laboratory spaces, including transfers or departures from the University and laboratory relocations. The Authorized User must notify the Radiation Safety Office **two (2) weeks** before departure from the University Campus. The Authorized User is responsible for surveying all spaces and equipment and proper removal of all radioactive waste and radioactive sources prior to the changes. Upon notification, the Radiation Safety Office will complete a final clearance survey of the authorized spaces. Radiation Warning signs may be removed only by the Radiation Safety Office.

All unused radioactive materials must be accounted for and turned over to the Radiation Safety Office for storage or disposal. Materials may be transferred to another authorized user following RSO approval.

6.14 NEW LABORATORY SETUP

New laboratories will be posted and set-up by the Radiation Safety Office. The Authorized User should contact the Radiation Safety Office to schedule the set-up. The Radiation Safety personnel will review policies and procedures and answer any other questions regarding radiation safety matters.

6.15 USE OF RADIOACTIVE MATERIALS IN THE OPERATING ROOM

The administration of radioactive materials (RAM) on patients shall be under the supervision of a physician who has appropriate training and experience and has been approved by the UAMS Radiation Safety Committee.

Procedures for Radioactive Material Use in the Operating Room:

- 1) Follow universal precautions to reduce potential exposure to radioactive contamination.
- 2) Perform area radiation surveys at the conclusion of the procedure to identify any areas of contamination. If necessary, decontaminate and resurvey.
- 3) Ensure that radioactive specimens are properly labeled prior to submission to the laboratory.
- 4) Radioactive waste should be placed into blue bags and labeled with the isotope, activity if known, date and time. Contact the Radiation Safety Office (501-686-7803 or 501-686-5550) to arrange for proper disposal of the waste.
- 5) Personnel dosimetry is provided by UAMS and should be worn by individuals routinely who are likely to exceed 10% of the annual exposure limit (500 mRem) whenever procedures involving patients administered radioactive materials are performed.

7.0 ANIMALS CONTAINING RADIOACTIVE MATERIALS

Injections of radioactive materials in animals shall be carried out in stainless steel trays having absorbent materials in the bottom. Surgical gloves shall be worn by the worker, for all levels of radioactivity requiring a radioactive materials sign.

7.1 CARE OF ANIMALS AND DISPOSAL OF RADIOACTIVE EXCRETIONS

- 1) All cages housing animals injected with radioactive material shall be clearly marked as follows:
 - a. Name of radioisotope
 - b. Amount of radioactive material injected per animal
 - c. Date of injection
 - d. Principal investigator's name
 - e. "Caution Radioactive Material" tape must be affixed to the cage.
- 2) All animal excreta, which may contain radioactivity, shall be collected and, if necessary, stored before disposal. It may be disposed of through the sewage system if the excreta is in a suitable form, i.e., not mixed with sawdust or wood shavings, and if it meets the limits specified in 6.9.5. If the excreta shows no significant activity above background when monitored by a survey meter appropriate to the radioisotope involved, it may be discarded with normal trash in a suitable container. In all other cases, the excreta shall be labeled with the name of the isotope and the estimated amount of activity, and stored prior to disposal by the Department of Occupational Health and Safety, in accordance with the rules for disposal (Section 6.9.5).
- 3) Animal caretakers shall be instructed and adequately trained by the laboratory supervisor with respect to general and specific handling procedures, dose levels, occupancy time limits and other special conditions. It is preferable that research personnel provide all animal caretaking duties whenever possible.
- 4) Ventilation should be adequate to handle possible evolution of airborne radioactivity. This may, in some instances, require the use of a fume hood or self-contained controlled environmental systems.
- 5) Animals containing radioactive materials will be housed in secure areas so that unauthorized access is prevented.

8.0 NURSING CARE OF PATIENTS RECEIVING RADIATION

Radiation is one of the many occupational risks to which nurses are exposed in a medical setting. Effective radiation safety practices will keep exposures to nursing personnel to a minimum.

8.1 CARE OF PATIENTS RECEIVING DIAGNOSTIC OR IMAGING EXAMINATIONS

- 1) Patients Receiving X-Ray examinations, CT examinations, or Fluoroscopic Procedures
 - a) Patient is not radioactive after these exams.
 - b) No extra care beyond normal practices is required.
 - c) If assisting in any of these procedures, request a lead apron and discuss concerns with radiology technologists.
- 2) Patients Receiving Nuclear Medicine or PET Examinations
 - a) Patient is radioactive after these exams
 - b) Patient fluids may be contaminated with radiation.
 - c) Normal universal precautions will protect nurses from contamination of radiation.
 - i) Wear gloves
 - ii) Wear eye protection and gown if risk of splatter or splashing
 - iii) Wash hands with soap and water after removing gloves instead of using hand sanitizer.

8.2 CARE OF PATIENTS RECEIVING THERAPEUTIC RADIOACTIVE MATERIALS

- 1) HDR therapy (High Dose Rate Remote Afterloader)
 - a) Performed in Radiation Oncology (ROC)
 - b) Patient is not radioactive nor contaminated with radiation post treatment.
- 2) Y-90 microspheres (Sir-Spheres, TheraSpheres)
 - a) Patient received tiny radioactive spheres that lodged in liver tumor
 - i) If received over 7 days prior, no additional precautions are needed.
 - b) Patient will not be contaminated with radiation
 - i) No concern of radioactive bodily fluids
 - c) Patient will emit a small amount of radiation
 - i) Exposure is not significant to impede any medical care.
 - ii) Stand three feet or more from the edge of the bed to talk to patient for more than 30 minutes.
- 3) Cs-131 GammaTiles
 - a) Patient received small patches in brain that contained radioactive seeds
 - i) If received over 7 days prior, no additional precautions are needed.
 - b) Patient will not be contaminated with radiation
 - i) No concern of radioactive bodily fluids
 - c) Patient will emit a small amount of radiation
 - i) Exposure is not significant to impede any medical care.
 - ii) Stand three feet or more from the edge of the bed to talk to patient for more than 30 minutes.

- iii) Recommended patient placement in a room that does not share a headwall with another patient.
 - iv) Patient must be surveyed by the radiation safety team to confirm their exposure rate before being discharged.
- 4) Ra-224 Alpha DaRTs
 - a) Patient received threads with radioactive seeds placed through a surface tumor
 - b) Contact Radiation Safety immediately if a thread comes out.
 - c) Patient will not be contaminated with radiation
 - i) No concern of radioactive bodily fluids
 - d) Patient will emit a small amount of radiation
 - i) Exposure is not significant to impede any medical care.
 - ii) Stand three feet or more from the edge of the bed to talk to patient for more than 30 minutes.
- 5) Ra-223 Xofigo
 - a) Patient received an injection of radioactive material to treat prostate cancer that has spread to the bones.
 - i) If received over 7 days prior, no additional precautions are needed.
 - b) Ensure Radiation Safety or Nuclear Medicine knows patient has been admitted.
 - c) Normal universal precautions will protect nurses from contamination of radiation.
 - i) Wear gloves
 - ii) Wear eye protection and gown if risk of splatter or splashing
 - iii) Wash hands with soap and water after removing gloves instead of using hand sanitizer.
 - d) Discard all waste containers in Blue Bags that may contain bodily fluids such as: emesis bags, bed pans, urinals (after contents disposed of in toilet flushing twice), and sharps. These will be picked up by Nuclear Medicine or Radiation Safety.
 - i) Contact Nuclear Medicine or Radiation Safety for Blue Bags.
 - e) Usually performed as an outpatient procedure, but if patient is later taken to the ER and/or admitted, the patient room needs to be surveyed for contamination upon discharge by Nuclear Medicine or Radiation Safety Personnel.
 - i) Contaminated waste will be collected and removed by surveyor.
 - f) Warning signage must be placed on Patient Door: "Caution – Radioactive Materials"
 - g) Patient will emit a small amount of radiation
 - i) Exposure is not significant to impede any medical care.
 - ii) Stand three feet or more from the edge of the bed to talk to patient for more than 30 minutes.
- 6) Lu-177 Lutathera
 - a) Patient received an infusion of radioactive material to treat gastroenteropancreatic neuroendocrine tumors.
 - i) If administered over 7 days prior, no additional precautions are needed.
 - b) Ensure Radiation Safety or Nuclear Medicine knows patient has been admitted.
 - c) Normal universal precautions will protect nurses from contamination of radiation.
 - i) Wear gloves
 - ii) Wear eye protection and gown if risk of splatter or splashing
 - iii) Wash hands with soap and water after removing gloves instead of using hand sanitizer.
 - d) Discard all waste containers in Blue Bags that may contain bodily fluids such as: emesis bags, bed pans, urinals (after contents disposed of in toilet flushing twice), and sharps. These will be picked up by Nuclear Medicine or Radiation Safety.
 - i) Contact Nuclear Medicine or Radiation Safety for Blue Bags.

- e) Usually performed as an outpatient procedure, but if patient is later taken to the ER and/or admitted, the patient room must be surveyed for contamination upon discharge by Nuclear Medicine or Radiation Safety Personnel.
 - i) Contaminated waste will be collected and removed by surveyor.
 - ii) Warning signage must be placed on Patient Door: “Caution – Radioactive Materials”
- 7) Lu-177 PSMA (Pluvicto)
- a) Patient received an infusion of radioactive material to treat prostate cancer.
 - i) If administered over 7 days prior, no additional precautions are needed.
 - b) Ensure Radiation Safety or Nuclear Medicine knows patient has been admitted.
 - c) Normal universal precautions will protect nurses from contamination of radiation.
 - i) Wear gloves
 - ii) Wear eye protection and gown if risk of splatter or splashing
 - iii) Wash hands with soap and water after removing gloves instead of using hand sanitizer.
 - d) Hold all waste that may contain bodily fluids such as: emesis bags, bed pans, urinals (after contents disposed of in toilet), and sharps.
 - e) Usually performed as an outpatient procedure, but if patient is later taken to the ER and/or admitted, the patient room must be surveyed for contamination upon discharge by Nuclear Medicine or Radiation Safety Personnel.
 - i) Contaminated waste will be collected and removed by surveyor.
 - ii) Warning signage must be placed on Patient Door: “Caution – Radioactive Materials”
- 8) I-131 Thyroid Therapy (Radioactive Iodine)
- a) If administered over 7 days prior, no additional precautions required.
 - b) ***Radiation Safety and Nuclear Medicine must be notified before patient is admitted.*
(Notify as soon as possible if admitted through Emergency Department)**
 - i) Warning signage must be placed on Patient Door: “Caution – Radioactive Materials”
 - ii) Room must be “papered” to cover all surfaces due to contamination risk.
 - c) Pregnant nurses should not be assigned to the care of these patients.
 - d) No visitors are allowed to enter the patient room during this treatment.
 - e) Nursing staff must wear a electronic dosimeter when attending to the patient and record dose on “Electronic Dosimeter Dose Log”
 - f) Nursing staff should limit their time of close contact to 30 minutes per shift.
 - g) Special Care Precautions:
 - i) Disposable gloves and shoe covers must be worn while attending this patient.
 - ii) All food and drink must be served in disposable containers. Food services should NOT enter the room. Excess food should be held in a blue trash bag to be surveyed before disposal.
 - iii) Lab test samples (blood, urine, etc.) must be collected before treatment begins, delayed, or approved by the Nuclear Medicine Physician Staff.
 - iv) Urine should NOT be collected during treatment unless specifically ordered and the patient is permitted routine use of toilet facilities. When a bedpan is used, contents may be disposed of the toilet in the patient room, taking care not to spill.
 - v) Should the patient vomit during the first 24 hours after the dose is administered, the vomitus (and sputum) should be disposed of via the toilet. All linens soiled by vomitus and materials needing to be cleaned should be placed in a blue plastic bag and shall be collected by Radiation Safety or Nuclear Medicine.

- vi) Separate containers (blue liner) will be provided for the linens and trash (paper, food trays). The containers must stay in the room until checked by Nuclear Medicine or the Radiation Safety Office.
- vii) If a spill occurs (e.g. patient blood, urine or vomitus), immediately call Nuclear Medicine (501-686-6661) or Radiation Safety (501-231-7408 or 501-605-3801). Place an absorbent pad over the spill but DO NOT attempt to clean up the spill.
- viii) Nursing staff should not provide assistance in bathing the patient. However, patients should be encouraged to shower often and drink lots of liquids which will aid in removing excess Iodine from their system. All towels must be held in blue bags to be collected by Nuclear Medicine or Radiation Safety.
- ix) The patient must remain in the room until released by the Nuclear Medicine Department or the Radiation Safety Office.
- x) Patient may only be discharged with Nuclear Medicine approval.
- xi) Room releases and reassignment requires approval of Nuclear Medicine staff and the Radiation Safety Office.
- h) Special Instructions for Responding to a Code for Patients undergoing Iodine-131 Therapy
 - i) The individual initiating the code may begin CPR or other life-saving procedures without regard for radioactivity, although a one way valve should be used if possible.
 - ii) The medical team responding to the code should wear gloves; shoe covers and gowns upon entering the room to assist the individual performing CPR. All personnel involved should wait to be surveyed for contamination by Radiation Safety or Nuclear Medicine.
 - iii) Access to the room should be limited to only pertinent staff necessary to initiate the code.
- i) Quick Reference Chart

	Possible Radiation Contamination	Wash hands with soap and water instead of foam	Blue Bag materials that may contain body fluids (linen, urinal, bed pan, etc.)	Discard sharps and syringes in container supplied by Radiation Safety	Signage for Door	Reassign pregnant nurses
HDR	No	No	No	No	No	No
Y-90 Sir or Thera Spheres	No	No	No	No	No	No
Cs-131 Gamma Tiles	No	No	No	No	No	No
Ra-224 Alpha Darts	No	No	No	No	No	No
Ra-223 Xofigo	Yes	Yes	Yes	Yes	Yes	No
Lu-177 Lutathera	Yes	Yes	Yes	Yes	Yes	No
Lu-177 PSMA Pluvicto	Yes	Yes	Yes	Yes	Yes	No
I-131 Radioiodine	Yes	Yes	Yes	Yes	Yes	Yes

Emergency Situations:

If there are any questions of contamination, techniques for handling contamination, or personnel exposure, the following individuals should be contacted.

Radiology Resident on Call Dept. of Radiology (Resident on Call) 501-296-1095
 Radiation Safety: 501-686-5536. If after hours Call Center: 501-526-0000

9.0 SAFE HANDLING OF CADAVERS CONTAINING RADIOACTIVE ISOTOPES

9.1 PROCEDURE AFTER DEATH OF PATIENT

If a patient, in the hospital, contains less than 5 mCi of any radionuclide, no special precautions are necessary. If a patient dies in the hospital and contains more than 5 mCi, the doctor signing the death certificate should inform the pathologist and the RSO of this fact. The funeral director's form shall be completed, and sent with the body. (Appendix IV)

If there is an autopsy, it may be necessary for the pathologist to take precautions detailed in 9.2. If there is no autopsy, and the body contains more than 5 mCi, the doctor signing the death certificate should notify the RSO who will prepare a statement for the FUNERAL DIRECTOR.

9.2 CONDUCT OF AUTOPSY

- 1) When a cadaver suspected to contain more than 5 mCi of radioactive material is to be autopsied, the RSO should be notified. The RSO will be present during the autopsy.
- 2) The amount of activity remaining in the body should be estimated by reference to the time elapsed since the administration of the isotope and its biological fate.
- 3) If the remaining amount is less than 5 mCi, no special precautions are necessary other than the usual wearing of gloves, except in cases of I-131 therapy, where the handling of the thyroid gland which contains most of the activity should be minimized.
- 4) Where the residual activity exceeds 5 mCi, the following procedures should be followed.
 - a) Survey the body before it is opened to establish maximum working times if necessary.
 - b) Drain carefully all body fluids and save for assay. In cases of I-131 therapy, the blood and particularly the urine will be radioactive.
 - c) After the body is opened, a second survey should be made to estimate levels of beta dose, particularly in the pleural or peritoneal cavity following treatment with Gold-198.
 - d) Where intense beta ray fields exist (e.g., from Phosphorus-32, Gold-198) the use of double gloves will significantly reduce the hand-dose. The working time inside the body will usually be limited by the acceptable exposure of the hands of the pathologist. The use of safety goggles or glasses is also recommended.
 - e) In cases of I-131, the thyroid gland will produce a gamma-ray dose of about 0.5 R/min near its surface for each 10 mCi in it, and consequently should not be touched by hand directly. Its removal, depending on the activity level, should be accompanied using long instruments.
- 5) Highly radioactive fluids should be turned over to the RSO for disposal.
- 6) All instruments and clothing involved in the autopsy shall be monitored after the procedure and stored or decontaminated before return to general use or dispatched to the laundry. The autopsy room shall also be surveyed and decontaminated if necessary.

9.3 PRECAUTIONS REGARDING EMBALMING

- 1) A radioactivity form should be filled out if the residual activity exceeds 5 mCi. (Appendix IV)
- 2) A body containing less than 5 mCi may be released directly to the funeral director for embalming without the advice of the RSO, and the form should indicate that no precautions are necessary for standard embalming procedures.
- 3) The RSO should recommend precautions, if necessary, on the form accompanying a body containing more than 5 mCi. Such precautions might include the wearing of rubber gloves by the embalmer, and the collection of body fluids.

9.4 PRECAUTIONS REGARDING PERMANENT IMPLANTS

- 1) Radioactive implants will not be a contamination hazard unless a seed is accidentally severed.
- 2) Permanent implants of low-energy gamma emitters (^{125}I , ^{103}Pd) do not normally present significant radiation hazards and therefore do not typically require removal for an autopsy to be performed.
- 3) If removal of the permanently implanted sources or tissue containing the sources is deemed most practical, the RSO must be contacted so that instructions for removal may be provided.

10.0 EMERGENCY PROCEDURES

In any radiation emergency, personnel protection and emergency medical care have priority over radioactive decontamination of the building and equipment. For all cases, the Radiation Safety Office (501-686-7803 or after hours, 501-526-0000) must be notified as soon as possible.

10.1 SEALED SOURCE RUPTURE

If the rupture of a sealed source occurs, or if potentially hazardous quantities of radioactive dusts, mists, fumes, organic vapors or gases are introduced into the air, the following emergency measures should be taken immediately:

- 1) No immediate attempt should be made to clean up the spill.
- 2) All windows should be closed, fans and air conditioners should be shut off, and everyone should leave the room.
- 3) All doors should be closed and locked.
- 4) If powdered or gaseous sources are involved, the door and all other openings leading into the room should be sealed with wide masking tape and heavy wrapping paper.
- 5) The spread of radioactive contamination can be diminished by restricting the movements of potentially contaminated persons to a local zone just outside the spill area until the extent of shoe and clothing contamination is determined.
- 6) Every person who might have been contaminated should be monitored for radioactivity, and, if contaminated, should remove their clothes and be decontaminated. If no means are available for monitoring, it should be assumed that the person is contaminated.
- 7) The RSO should be called immediately. If necessary, outside consultants experienced in radiation hazards will be called in and their advice followed.

10.2 RADIOACTIVE LIQUID SPILLS

All spills of radioactive material must be cleaned up promptly. The responsibility for cleaning or for calling for experienced help rests on the individuals working in the area involved and responsible for the spill. A major spill is defined as an uncontrolled and inadvertent release of radioactive material which in a research lab exceeds 100 microcuries and does not involve airborne contamination. Under no circumstances should any untrained person attempt to examine or clean up a major spill of radioactive material.

(The clean-up technique should be planned with the same care as is used in quantitative chemical analyses or in bacteriological handling of virulent organisms.) Fans or ventilating apparatus should not be turned on in an attempt to blow the isotope or its decay products away. Such a maneuver will only disseminate the radioactive material throughout the area. If the isotope is blown out of a building, air currents may carry the finely divided material into nearby or air-intake ducts. Proper precautions taken immediately will protect human life and reduce financial losses. In the case of some isotopes with long half-lives, expensive equipment or entire buildings have been rendered useless. When decontamination is possible it can run into millions of dollars, depending on the extent

and nature of the contamination. Precautions taken in the first few minutes after an accidental release of radioactive material can mean the difference between inconvenience and disaster. The RSO shall be notified immediately of all accidents involving possible body contamination or ingestion of radioactivity by personnel, over-exposure to radiation, contamination of equipment, spread of contamination or difficulty in cleaning up a contaminated area. The RSO must be notified immediately in the event of loss of radioisotopes.

A *minor incident* with radioactive materials is an abnormal occurrence involving low amounts (generally less than 100 microcuries in a research lab; generally less than 100 millicuries in the nuclear medicine or PET department) of radioactive materials, where the worker handling the spill knows how to clean it up, has the decontamination materials on hand, and can respond without incurring risk of exposures or spreading within a reasonably short time.

A *major incident* is an abnormal occurrence involving larger amounts (generally greater than 100 microcuries in a research lab; generally more than 100 millicuries in the nuclear medicine or PET department) of radioactive materials, high risk nuclides, large areas contaminated contamination of the skin, airborne radioactivity, or any situation where contamination may have been spread outside the authorized area. Major spills must be reported to the RSO or his/her designee immediately, as required by state and federal law. Call the OH&S Office (501-686-5536) during working hours or the Call Center (501-526-0000) during non-working hours.

An *emergency* is an incident which involves serious injury or death, fire, explosion, or significant release of health or life threatening material, which is or may be coupled with a minor or major radiological incident. **NOTIFY CAMPUS OPERATIONS CALL CENTER IMMEDIATELY IF AN EMERGENCY HAS OCCURRED!! 501-526-0000**

In the event of a **MINOR** incident, these procedures should be followed:

- a) Notify the authorized user and persons in the room at once.
- b) Permit only the minimum number of persons in the area necessary to deal with the spill.
- c) Confine the spill immediately.
- d) Put on protective gloves and drop absorbent paper on a liquid spill.
- e) Decontaminate, using a survey meter or wipes to check the progress of the work.
- f) Monitor all persons involved in the spill and the cleaning.

In the event of a **MAJOR** incident, the following procedure should be instituted:

- a) Notify all persons in the area that a major spill or incident has occurred and evacuate unnecessary personnel. Notify the authorized user and the RSO.

- b) If hands are protected from contamination (i.e., gloves), right the container of the spilled liquid. If possible, shield the source, but only if it can be done without significantly increasing your radiation exposure.
- c) If the spill is on clothing, discard outer clothing at once.
- d) Vacate the room and lock the doors in order to prevent entry.
- e) If skin contamination has occurred, measure levels of contamination with a survey meter, record, and begin decontamination by gentle washing with warm water and soap, washing downwards towards extremities, not upwards.

In the event of an **EMERGENCY** in which radioactive materials are involved, the following procedure should be instituted:

- a) Notify all persons in the area that an EMERGENCY has occurred and evacuate the area if a risk to persons present exists.
- b) Notify CAMPUS OPERATIONS CALL CENTER (501-526-0000) of the nature of the emergency, number of persons involved, and the location.
- c) AWAIT THE EMERGENCY RESPONDERS who will assist and provide direction, as well as contact any other necessary responders.

10.3 EMERGENCY SURGURY ON PATIENT CONTAINING RADIOACTIVE MATERIALS

Unsealed Radionuclide Therapy Patients:

If an unsealed radionuclide (liquid) therapy patient undergoes emergency surgery or dies, it is necessary to ensure the safety of others attending the patient. As long as the patient's body remains unopened, the radiation received by anyone near it is due almost entirely to gamma rays. The change in emphasis when an operation or autopsy is to be performed is due to the possible exposure of the hands and face to relatively intense beta radiation. Procedures for emergency surgery or autopsy can be found in Section 5.3 of NCRP Report No. 37, "Precautions In The Management of Patients Who Have Received Therapeutic Amounts of Radionuclides".

The following procedures should be followed:

- a) If emergency surgery is performed within the first 24 hours following the administration of I-131 sodium iodide, fluids (e.g., blood, urine) will be carefully removed and contained in a closed system.
- b) Protective eyewear will be worn by the surgeon and any personnel involved in the surgical procedure for protection of the eyes from possible splashing of radioactive material and exposure from beta radiation (if applicable).
- c) The RSO will direct personnel in methods to keep doses ALARA during surgical procedures.

- d) If an injury occurs during surgery that results in a cut or tear in the glove used, the individual involved will be monitored to determine if radioactive material was introduced into the wound. The RSO will be informed of any possible radiation hazard.

Permanent Sealed Source Implant Patients:

Permanent implants of low-energy gamma emitters (^{125}I , ^{103}Pd) do not normally present significant radiation hazards. If surgery is performed less than two years post implant shielding, such as a radiology lead apron, placed over the patient's pelvic region may be used to reduce radiation exposure to the OR staff.

If surgery is performed to remove tissue containing radioactive sources, the RSO (501-686-7803) should be contacted so that the sources can be properly disposed. Sources more than 2 years old (more than 2 years post implant) may be disposed as tissue waste in a biohazard container. If the sources are less than 2 years old (less than 2 years post implant) the sources must be retained, held for decay and disposed after ten half-lives.

11.0 RADIATION SAFETY IN THE USE OF X-RAYS

11.1 GENERAL

The purchase, installation, and safe use of all x-ray equipment within the UAMS Campus are subject to the policies established by the Radiation Safety Committee and regulations promulgated by the Arkansas State Health Department.

11.2 REGISTRATION

All machines capable of producing ionizing radiation **must** be registered with the UAMS Radiation Safety Office (OH&S). Registrants using X-ray machines shall provide the Radiation Safety Office with documentation of the type, make, model, location, and maximum output of the x-ray device before installation.

11.3 INSPECTIONS

The State Radiation Control Branch of the Arkansas Health Department inspects medical x-ray equipment periodically or as requested. The RSO or Medical Physics Consultant inspects x-ray equipment annually. These inspections are conducted to meet the requirements of Arkansas regulations and/or the Joint Commission.

11.4 PERSONNEL MONITORING

Personnel who use penetrating radiation generating equipment must use whole body badges. Signs warning of radiation must be posted near radiation producing equipment. (See Appendix III)

11.5 SAFETY POLICIES FOR DIAGNOSTIC RADIOLOGY

- 1) Any personnel performing diagnostic x-ray imaging studies on humans anywhere on the UAMS campus must:
 - a. Hold a non-limited registry certificate, in good standing, with the American Registry of Radiologic Technology (ARRT) and hold a non-limited license in good standing issued by the Arkansas Department of Health, Radiologic Technology Licensure Program, or
 - b. Graduates of accredited radiological programs, who are national certification eligible, must hold a current temporary license in good standing with the Arkansas Department of Health, Radiologic Technology Licensure Program. Upon expiration of the temporary

licensing, the graduate must provide proof of current non-limited national certification (ARRT) in good standing, and a current non-limited license in good standing with the state of Arkansas.

- c. Exceptions to 1.a. and 1.b. are in accordance with Arkansas State Board of Health Rules and Regulations pertaining to Radiologic Technology Licensure,
 1. Section V. Exceptions: A.: “Licensed Practitioners, individuals licensed to practice medicine, dentistry, podiatric medicine, chiropractic, optometry or osteopathy in this state, dental hygienists, registered dental assistants with the expanded duty of radiography, radiation health physicists, radiation medical physicists, chiropractic externs, bone densitometrists and certified medical dosimetrists are exempt from the requirement of obtaining a license to apply ionizing radiation or administer radiopharmaceuticals”, or
 2. Section VI. Licenses Required: C.: “A Limited Licensed Technologist License is required for any individual who is under the supervision of a Licensed Practitioner and uses medical equipment emitting ionizing radiation for human diagnostic purposes for radiographic examination of the chest or skeletal areas. This license is obtained by successful completion of the examination by the American Chiropractic Registry of Radiologic Technologists or an examination approved by the Arkansas State Board of Health.” Limited Licensed Technologists should only be used in regional UAMS clinics where employment of a non-limited Licensed Technologist would not be possible.
- 2) Immobilizing procedures or devices are to be used whenever possible for patients who cannot cooperate or the examination requires strict motion control. Hospital personnel, guests, or family may be called on to assist when other restraints are not possible. No individual is to be used for patient holding routinely; however, when holding the patient is necessary, the holder is to be provided and must wear protective apron and gloves. Members of the Radiology Department are not to hold patients except as a last resort. (Residents and Radiologic Technology students are considered members of the Department.)
- 3) Gonadal shields are to be used on patients of reproductive or younger age who have not been permanently sterilized and the presence of the shield will not obscure clinically significant information.
- 4) Technologists who operate mobile x-ray generators are responsible for the safety of themselves and others in the immediate area of the patient. As a minimum requirement, the Technologist will 1) wear and/or provide lead aprons for personnel less than 6 feet from the patient; 2) assure that only the patient is within the primary x-ray beam; and 3) remove all others to a distance of 6 feet from the patient during actual exposure.
- 5) Total filtration equal to 2.5 mm Al (or slightly more) is provided on all x-ray tubes capable of operating above 70 KV. This is not to be altered except in the case of Mammography (0 to 50 KV - 0.5 mm Al; 50 to 70 KV 1.5 mm al).
- 6) Collimation is to be used to restrict the primary beam to the area of clinical interest. At no time should the beam be larger than the image receptor by more than 2% of the SID. (i.e., SID =72” collimator to within 2” of the film.)

- 7) In fluoroscopy, the “tube-on” time will be kept as short as possible and the “field-of-view” will be kept as small as possible without compromising quality or increasing “tube-on” time.
- 8) Lead aprons are to be worn by personnel conducting or assisting in fluoroscopic examinations.
- 9) Radiation Dosimeters are required by Arkansas regulations for all personnel who are directly involved in radiological examinations. Dosimeter users are responsible for the care and timely exchange of these devices.
- 10) Doors to radiographic and fluoroscopic rooms are an integral part of the shielding required for these facilities. Doors are to be closed during all x-ray exposures.
- 11) Technologists are responsible for seeing that lead aprons are available for all persons involved in fluoroscopic and portable unit procedures.
- 12) Clean and neat floors and work benches are not only to be expected in a hospital setting, it is the responsibility of the technologist in charge of a room to see that equipment is clean and in good working condition. Any soiling or unsafe condition which cannot be immediately corrected must be reported to the Senior Technologist on duty.
- 13) Cassettes must be cleaned and dried before returning them to use when they become soiled.
- 14) The quality of examinations and the safety of personnel and patients are of the highest priority and is the personal responsibility of each member of the staff to identify, notify and assist in correcting deficiencies as they occur.

11.6 USE OF RADIATION IN THE OPERATING ROOM

Procedures for the use of radiation in the operating room

- 1) Radiography and/or Fluoroscopy must be performed by a physician or an individual meeting the requirements outlined in Section 11.5.
- 2) Lead aprons are provided by UAMS and should be worn whenever radiography is performed. Lead aprons must be worn during fluoroscopy by individuals within a 6 foot radius of the patient. Lead thyroid shields should be worn during fluoroscopy by individuals within a 3 foot radius of the patient.
- 3) Personnel dosimetry is provided by UAMS and should be worn by individuals routinely who are likely to exceed 10% of the annual exposure limit (500 mRem) or whenever radiography and/or fluoroscopy procedures are performed.
- 4) Safety procedures listed in Section 11.5 above should also be followed as appropriate.

11.7 PATIENT EXPOSURE DURING FLUOROSCOPY

- 1) Threshold limits are set for fluoroscopic procedures and recommended procedures for follow-up when skin doses have exceeded 3,000 mGy for adults and 1,000 mGy for pediatric patients.
- 2) A record must be kept of each fluoroscopic procedure in which the total dose to a single field exceeds 3,000 mGy for adults and 1,000 mGy for pediatric patients. All cases in which the fluoroscopic dose exceeds these thresholds will be entered into Patient Safety Net by the responsible physician or a technologist involved in the case. The RSO will review all reported cases.

3) For each fluoroscopic procedure with a dose to a single field exceeding 3,000 mGy for adults and 1,000 mGy for pediatric patient dose information will be included in the electronic medical record, either in a procedure report or progress note. The record shall include:

- **procedure name**
- **provider supervising the fluoroscopy**
- **date of the procedure**
- **fluoroscopy unit or room used**
- **specific patient information**
- **total fluoro time**
- **cumulative dose in mGy including image recording**
- **estimated peak skin dose and locations**
- **dose-area-products**
- **methods used to decrease radiation dose**

4) Recommended follow up procedures are as follows:

Level I (Pediatric): 1,000 mGy or above:

- Provide discharge instructions for post radiation exposure.
- Patient education to include self-examination for skin erythema and reporting of any radiation effects to the physician.
- Initiate Patient Safety Event Report - Classify as Radiology/Imaging Test – Unanticipated radiation exposure.

Level I (Adult): 3,000-7,999 mGy:

- Provide discharge instructions for post radiation exposure.
- Patient education to include self-examination for skin erythema and reporting of any radiation effects to the physician.
- Initiate Patient Safety Event Report - Classify as Radiology/Imaging Test – Unanticipated radiation exposure.

Level II: 8,000 mGy and Above:

- Provide discharge instructions for post radiation exposure.
- Patient education to include self-examination for skin erythema and reporting of any radiation effects to the physician.
- Radiation Exposure Report form (Appendix XII, Attachment A) completed and submitted to the RSO.
- Initiate Patient Safety Event Report - Classify as Radiology/Imaging Test – Unanticipated radiation exposure.
- 10-14 days - Follow up with a telephone appointment with the patient.
- 28-32 days - Follow up with a telephone appointment with the patient.
- Dermatology consult within 7 days if erythema is present at 28-32 day call. Consult to include contraindication of performing punch biopsies on patients with skin injuries unless medically necessary.
- Follow up care documentation to be entered in medical record.

APPENDIX I

Acceptable Training and Experience for Authorized Users of Radiation Sources.

A. GENERAL

There are four categories of use for the purposes of training and experience evaluation. They are in vitro applications, animal applications, routine human use for diagnosis or treatment, and experimental use in humans. An applicant is required to describe the intended project sufficiently for the Radiation Safety Committee to make a sound judgment regarding his/her level of ability. The Committee's primary concern is for the safety of the applicant, coworkers, the UAMS community and the general public.

B. BASIC TRAINING

All authorized users regardless of the category of intended use, are expected to have working knowledge of the following areas. A minimum of 20 hours of formal training is required.

1. Principles, practices, and policies of radiation protection.
2. Methods of measurement, standardization, and monitoring of radiation sources and the associated instrumentation.
3. Basic mathematics and calculations fundamental to the use and measurement of radiation and radioactivity.
4. Biological effects of radiation.
5. Familiarity with the UAMS Radiation Safety program.
6. Experience in the uses for which application is made.

C. HUMAN USE OF RADIATION SOURCES:

1. **Routine Use** (well established procedures as identified by the FDA and/or Arkansas Department of Health, Radiation Control) The use of radiation following proven procedures for routine diagnosis or treatment must be under the supervision and control of a physician licensed to dispense drugs in Arkansas. In addition, the physician shall provide evidence of the following experience:
 - a) Supervised examination of patients to determine the suitability for radioisotope or x-ray diagnosis and/or treatment and recommendation on dosage to be prescribed;
 - b) Collaboration in calibration of the dose and the actual administration of the dose to the patient, including calculation of the radiation dose, related measurements, and plotting of data;
 - c) Adequate period of training to enable the physician to manage radioactive patients and to follow patients through diagnosis and/or the course of treatment;

- d) Study and discussion with preceptor of case histories to establish most appropriate diagnostic and/or therapeutic procedures, limitations, contra-indications, etc.

For specific training requirements see the Arkansas Licensing Guide for the Use of Radioactive Material in the Healing Arts, Appendix B, Parts I and II.

2. **Non-routine Use** (experimental use of radiation sources in human subjects). Experimental use of a radiation source may be either of the following situations.
 - a) A new Radiopharmaceutical or a new use of a Radiopharmaceutical applied to the diagnosis or treatment of medical problems.
 - b) The use of an established test using a radiation source, either isotopic or diagnostic radiographic (i.e., x-ray) which is conducted as part of an experimental project. In this case the concern is with the primary research and the use of radiation is indicated only to evaluate the experimental use of another drug or procedure.

Applications for experimental or non-routine uses of radiation sources are reviewed with the assistance of the UAMS Institutional Review Board. Applications should be supported by a research protocol which includes:

- 1) Title of study.
- 2) The purpose of conducting the study. Indicate whether the study is to be clinical research or clinical evaluation and explain why.
- 3) The plan of investigation in sufficient detail to permit a critical evaluation of the methods for conducting the experiments and the controls established.
- 4) A statement as to whether any planned complementary drug or radioisotope administration is contemplated in conjunction with the study.
- 5) A statement about the expected fate of the isotope administered and if the procedure is for therapy, a statement about the expected effects.
- 6) If the application is for clinical research,
 - a) An outline of related work conducted by the applicant or others in laboratory animals and in humans, including data on localization, effective half-life, and radiation dosage. If no work has been conducted in animals, explain why. Pertinent references and a brief abstract prepared by the applicant of published or unpublished material should be submitted. (The brochure of a commercial supplier is not a satisfactory authority for this purpose. It is not necessary to include with the application reprints of references.)
 - b) If the application is for clinical evaluation, pertinent references and a brief abstract prepared by the applicant of published or unpublished material, including information on localization, effective half-life, and radiation dosage. (The brochure of a commercial supplier is not a satisfactory authority for this purpose. It is not necessary to include with the application reprints of references).
- 7) A description of the human subjects to be studied:
 - a) Persons without manifest disease—number, method of selection, age range.
 - b) Persons with manifest disease—number, nature of pathology, method of selection, age range.

- c) Pregnant women shall ordinarily be excluded from any test not involving the condition of pregnancy itself. Specify whether or not pregnant women will be tested, and if so, explain why.
- 8) Confirmation that consent of human subjects or their representatives will be obtained to participate in the investigation except where this is not feasible. The consent will include the estimated radiation exposure in terms understandable to the patient.
 - 9) The radioisotope dose range (Becquerels, microcuries or millicuries) to be administered and the method of administration.
 - 10) Calculations of the radiation doses delivered to the whole body and to the critical organ(s). The calculations shall contain information about:
 - a) The expected half-life in various organs.
 - b) The relationship between the retained isotope and the permissible body burden for occupational exposure (except for therapy).
 - c) The rationale for using the dose selected.
 - d) The radiation dose due to other simultaneous or accompanying radioactive isotope test which may be administered.
 - 11) In Radiopharmaceutical uses, the evaluation of body and organ doses is to be done using the MIRD formulation and tabular data.
 - 12) If x-ray exposure is involved, whole body and organ dose assessment will be done.
 - 13) A statement of the institutional resources available to support the study including:
 - a) Physical facilities and equipment especially suited for the study under consideration.
 - b) Availability of clinical material.
 - c) Types of consultation or collaboration available including the name of the sponsor of the study if other than the applicant.
 - 14) A summary of research training and experience and pertinent training or experience in the use of radioisotopes by the individual physician who will be responsible for the study. ADH Licensing guide, Appendix A, Parts I and II will be used to determine appropriate training.

APPENDIX II

PROCEDURES FOR REQUISITUION AND USE OF PERSONNEL DOSIMETERS

Federal and State laws specify the wearing of personnel dosimeters for individuals entering controlled areas in which they will receive, or are likely to receive, 10% of the annual occupational limit, (see section 6.2.2). Declared pregnant employees are subject to more restrictive radiation exposure limits. These employees should contact the RSO for consultation about ways of minimizing their radiation exposure during the pregnancy and other information related to the UAMS policy for pregnant employees.

Ring thermoluminescent dosimeters (TLDs) are required for individuals working in the Nuclear Medicine or PET Department and recommended for personnel working with millicurie quantities of P-32, I-125 or any gamma emitters.

PERSONNEL DOSIMETER REQUISITION:

The radioisotope user, supervisor, or department head, is responsible for seeing that each person under his control is issued a radiation dosimeter by the RSO, when his (her) activities may result in exposures greater than 10% of the annual dose limits (see section 6.2.2).

Dosimeters will be issued when the following information can be supplied: the prospective wearers' name, social security number, date of birth, room number or department, and the name, address, and dates of any previous occupational radiation exposure. If the individual has previous occupational radiation exposure, State regulations require UAMS to request their exposure history from their previous employers. Forms will be provided.

If there is any doubt about the advisability of a person wearing a radiation dosimeter, badges can be issued for a six-month trial period to determine the routine exposure levels.

USE:

There are three primary reasons for wearing a dosimeter.

- 1) To assure that the radiation exposure of the individual is within the established "safe" limits as set up by National and International Radiation Protection Commissions and to comply with state and federal regulations.
- 2) To alert the RSO and the individual wearer of changes in procedures or work habits which result in increased radiation exposure.
- 3) To fulfill the UAMS' legal and moral responsibility to maintain records of radiation exposure and keeping exposures ALARA.

As with most sensitive instruments, there are precautions which must be observed in order that the measurements derived are accurate and reliable.

- 1) The dosimeter should never be exposed to liquids, excessive heat or mechanical stress. Do not wash and/or dry the radiation dosimeters in the laundry.
- 2) The dosimeter should never be stored in such a way that it will be exposed to more radiation than the person to whom the badge is assigned.
- 3) The dosimeter should never be worn during personal medical radiation treatments or x-rays. (The radiation dose of interest is only occupational.)
- 4) The dosimeter should always be worn when conducting procedures using ionizing radiation.
- 5) The dosimeter should be worn on the side of the body nearest the radiation source. The badge should be worn at the collar or waist.
- 6) Ring TLDs should be worn beneath protective gloves to prevent contamination of the ring or accidental disposal when the gloves are removed.
- 7) Ring TLDs may be rinsed in tap water, but excessive soap should not be used.
- 8) Lost, damaged or contaminated dosimeters should be reported immediately to the Radiation Safety Office.
- 9) Radiation dosimeters are exchanged monthly. The dosimeter and the ring TLD should be returned promptly at the first of each month after replacement dosimeters are received. If you do not receive replacement dosimeters, please notify the Radiation Safety Office.

EXCHANGE OF RADIATION DOSIMETERS:

Each authorized user, supervisor, or department head, will assign one person to collect and distribute dosimeters (Badge Coordinator). The new replacement dosimeters will be sent to the designated person at the first of each month. All exchanges should be made as soon as possible. Old previously worn dosimeters must be returned to the Radiation Safety Office by the fourteenth (14) of each month. Radiation dosimeters not returned in a timely manner may not provide an accurate dose assessment. It is imperative that dosimeters damaged, contaminated or lost be reported to the RSO immediately.

The Badge Coordinator should not collect the previous month's dosimeters until replacement dosimeters are received. If replacement dosimeters are not received by the second of the month, the Badge Coordinator should contact the Radiation Safety Office immediately at 501-686-5536.

POSTING OF EXPOSURE REPORTS

Exposure reports will be sent to the Badge Coordinator in each department around the end of the month. These reports must be posted where all monitored personnel can review their exposure readings. If employees have questions concerning their occupational radiation exposure, they may contact the RSO at 501-686-7803.

Whole body, deep dose exposures exceeding 100 mrem per month will be investigated by the Radiation Safety Office. A questionnaire will be sent to each person exceeding 100 mrem to

determine if any mechanical or procedural errors existed. Recommendations may be made to reduce future exposures. (The exception to the 100 mRem investigational limit is for the individuals who perform PET imaging and perform interventional fluoroscopic procedures. These jobs will routinely expose the individual to greater than 100 mRem in a given month when work load is heavy. The 300 mRem investigational limit will apply to these job duties.)

UNRETURNED DOSIMETERS:

Each department is supplied dosimeters for each participant and it to be returned no later than the eighth (8) of each month. UAMS is charged a fee for every badge not returned. Unreturned dosimeters will result in progressive disciplinary actions.

APPENDIX III

UNIVERSITY OF ARKANSAS FOR MEDICAL SCIENCES
LITTLE ROCK, ARKANSAS

Report of Radioactivity to Funeral Director

It is hereby certified that the body of _____

has been examined this date with the following results:

(CHECK ONE)

The body contains less than 5 mCi of radioactive material and requires no special precautions if standard embalming procedures are employed.

The body contains more than 5 mCi of radioactive material, and the following precautions are recommended:

Signed _____
Title _____
Date _____

APPENDIX IV

Application forms for Radioactive Material Use:

Form 1- Application for Radionuclide Use

Form 2- Training and Experience Supplement

Form 3- In Vivo Animal Use Supplement

APPLICATION FOR RADIONUCLIDE USE

(Form 1, continued)

5. DESCRIPTION OF HOW RADIONUCLIDES WILL BE USED AND CONTAMINATION PREVENTED

(Give special attention to procedures that have potential of contamination - centrifugation, evolution of gases, vapors, etc.):

University of Arkansas for Medical Sciences
APPLICATION FOR RADIONUCLIDE USE
(Form 1, continued)

6. RADIATION SAFETY PROCEDURES TO BE FOLLOWED: FACILITIES & EQUIPMENT, ETC.
(Attach separate pages as necessary).

- a. Procedures to ensure radionuclides are not lost or stolen.

- b. Posting and labeling practices.

- c. Contamination control measures (trays, gloves, adsorbent paper, etc.).

- d. Fume hood availability.

- e. Radiation survey meter availability (model and serial number)

- f. Liquid Scintillation Counter (model and serial number)

- f. Shielding devices (type)

- g. Personnel Dosimetry.
_____ Whole Body badges _____ Ring badge _____ Bioassay.

- i. Transport of radioactive material/tissues

- h. Other.

**University of Arkansas for Medical Sciences
APPLICATION FOR RADIONUCLIDE USE**

FORM 2 - TRAINING AND EXPERIENCE SUPPLEMENT (Attach to Form 1)

1 INVESTIGATOR NAME:

Principal Investigator Name:		Title:	
Email:		Phone:	
Department:		SAP:	

2. FORMAL TRAINING:

a. List Dates and Institution(s):

b. List number of clock hours for each of the following subjects covered (20 hours total required for P.I.):

Description of Training Course	Approximate # of Hours	Location/Institution	Date
Principles of Radiation Safety			
Radiation measurement, monitoring techniques and instruments			
Mathematics & calculations basic to sue measurement of radiation			
Biological effects of radiation			
<u>Other (specify)</u>			

c. Is a copy of certification of training attached to application? _____ **yes** _____ **no**

3. EXPERIENCE WITH RADIATION SOURCES:

Dates	Institution	Nuclide	Max Amount (mCi)	Type of Use

4. RADIATION EXPOSURE HISTORY: Give address (es) of facilities where you have been issued personnel monitoring (film badges, ring badges) or where bioassays (thyroid uptake, urinalysis) have been performed. (Include dates).

Dates	Monitoring Type	Bioassay Type	Facility and Address

5. CERTIFICATION: I certify that the above information is correct to the best of my knowledge and I authorize release of my previous radiation exposure history as described above.

SIGNATURE:

DATE:

FORM 3 - IN VIVO ANIMAL USE SUPPLEMENT (Attach to Form 1)

NAME OF INVESTIGATOR: _____

1. ANIMAL MODEL:

Type:		Frequency and Duration of Use:	
Average Weight:		Housing Location:	
Total Number to be Used:		Experiment Location:	

2. RADIONUCLIDE ADMINISTRATION:

Nuclides to be used:		uCi/administration:	
# of administrations/animal:		Method of administration:	

3. BIOLOGICAL DATA:

Excretion Routes:	
% of nuclide in each excretion route:	
Animal will be sacrificed (yes or no)	
If yes: Length of time from admin to sacrifice	
Amount remaining in Carcass:	
Animal will be transported (yes or no)	
If yes: Please describe process to prevent contamination	

4. ADDITIONAL RADIATION SAFETY PROCEDURES TO BE FOLLOWED AND ANIMAL CARETAKER INSTRUCTIONS:

TO BE COMPLETED BY RADIATION SAFETY:

Precautions to be observed until: _____

Special Precautions:

- _____ Decontaminate cages before re-use
- _____ Special containers for waste
- _____ Animal room to be surveyed after experiment
- _____ Masks to be work
- _____ Other (Specify)

APPENDIX VI

UNIVERSITY OF ARKANSAS FOR MEDICAL SCIENCES RADIOACTIVE MATERIAL ENFORCEMENT POLICY

The Radiation Safety Office is required to conduct a minimum of an annual review of the laboratory activities performed by authorized users of radioactive material. The actual number of audits an authorized user receives in a year can vary according to the volume and use of radioactive materials.

During the audit, items listed in the radiation safety manual are evaluated to determine the user's compliance with the regulations. The following items are evaluated:

1. Performs and documents contamination surveys as required by use.
2. Maintains a current inventory of all radioactive materials in the possession of the authorized user.
3. Records use and disposal of all radioactive materials.
4. Provides proper storage and labeling of radioactive material.
5. Ensures adequate security (Locks laboratory doors when lab is not occupied).
6. Maintains acceptable radiation and contamination levels in the laboratory.
7. Ensures proper posting of signs and notices in the laboratory.
8. Prohibits smoking and the use of food or drink in the laboratory.
9. Radioactive waste is maintained according to procedures outlined in the Radiation Safety Manual.
10. Ensures all personnel comply with the recommendations to wear film badges or other forms of radiation dosimeters.

At the completion of the laboratory audit, a letter is sent to the authorized user stating the results. If infractions or items of non-compliance are noted during the audit, each item is outlined for the authorized user with recommendations for compliance.

When items of non-compliance are present, the authorized user must submit a **written** response outlining the new procedures to ensure future compliance. This response must be received by the Radiation Safety Office within **30 calendar days** of the audit.

Failure to comply with the 30 day time period may result in the **loss of user privileges**, i.e., no radioactive material can be purchased, used, or received until compliance with all rules and regulations is documented.

Follow-up audits will be used to evaluate efforts to correct any items of noncompliance. If items of noncompliance are not corrected and are noted on follow-up audits, **user privileges may be revoked until the authorized user addresses each infraction.** The Radiation Safety Committee will evaluate the efforts and results of the authorized user in correcting items of noncompliance.

SUMMARY OF ACTIONS:

1. Audit with infractions - letter to authorized user.
2. 30 days to submit written documentation outlining methods to ensure future compliance.
3. Follow-up audit to assess correction of infractions.
4. Failure to comply with the rules and regulations set forth by the Arkansas Department of Health, UAMS Radiation Safety Committee, Radiation Safety Office and the Radiation Safety Manual may result in the loss of user privileges.

APPENDIX VII

Radioisotope Inventory and Disposal Log Sheet Instructions for completing record.

All use and disposal of radioisotopes should be recorded on the appropriate radioisotope inventory and disposal log sheet. Each use of radioisotopes should be documented by entering the date, amount used, and the amount disposed of by each of the listed disposal methods.

All usage should be recorded in **millicurie** (mCi) units. Using units of volume, such as microliters, is ineffective because the specific activity of each shipment is not known and the conversion to units of activity cannot be done.

Radioisotope decay can be ignored for the purposes of recording usage and disposal on the log sheet.

The following list gives the use of the different columns found on the log sheet.

1. **Date**- The date the material was used. Each use of the radioisotope should be recorded on the log sheet immediately.
2. **mCi**- The total amount of activity removed from the container during a particular usage.
3. **Drain**- The amount of activity that is disposed of by pouring it down the drain or sanitary sewer.
4. **Vials**- The amount of activity disposed of in liquid scintillation vials to be disposed of by OH&S.
5. **Animals**- The amount of activity in animal carcasses or tissues.
6. **Solid**- The amount of activity in dry solid form, placed in blue bag waste containers.
7. **Liquid**- The amount of activity found in collected liquid waste. The container should be appropriate for the liquid or chemical found in the waste.
8. **Transferred**- The amount of activity transferred to another approved or authorized user of radioactive material. OH&S should approve all transfers before the transfer occurs.

All columns should be totaled at the end of isotope use. All activity should be accounted for on the disposal log. The log sheet or a photocopy should be returned to OH&S when use of the radioisotope is complete. Each radioisotope shipment remains in your possession until the completed log sheet is returned to OH&S.

APPENDIX VIII

UAMS Policies:

1. Removal, Disposal, and/or Transfer of Equipment used with Radioactive Material

[Campus Policy No. 11.4.22](#)

To establish the procedures at the University of Arkansas for Medical Sciences (“UAMS”) to follow in the removal, disposal, and/or transfer of equipment that has been used in conjunction with radioactive materials.

2. Radioactive Substances

[Campus Policy No. 11.4.09](#)

To establish the procedures for the procurement, receipt, storage and transfer of radioactive materials within the University of Arkansas for Medical Sciences (“UAMS”) campus.

3. Pregnant Employees Working with Ionizing Radiation

[Campus Policy No. 11.4.10](#)

To provide information, training, and options to pregnant employees so that they can make informed decisions in the best interest of themselves and their fetuses; and provide a mechanism whereby UAMS can manage or implement appropriate safety practices.

APPENDIX IX

NOTICE TO EMPLOYEES

Arkansas Department of Health STANDARDS FOR PROTECTION AGAINST RADIATION

The Arkansas Department of Health (ADH) has adopted regulations with standards to protect you from hazards associated with radioactive materials and radiation emitting machines which are licensed or registered by ADH. In particular, the following information is available for your review:

Section 3: Standards for Protection Against Radiation
Part N: Notice, Instructions, and Reports to Workers; Inspections
Any other documents your employer must provide.

These may be found at the following location:

Radiation Safety Office, Hospital G-154 In Case of Emergency, Contact: Laura Hanson, RSO at 686-7803 For After Hours Emergency Only, Contact Laura Hanson at 501-231-7408

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to:

1. Comply with all applicable regulations and the conditions of the license or registration.
2. Post or otherwise make available to you a copy of the regulations, licenses, and operating procedures which apply to work in which you are engaged, and explain the provisions to you.

YOUR RESPONSIBILITY AS A WORKER

You should:

1. Know the provisions of the ADH regulations, the precautions, the operating procedures, and the emergency procedures which apply to your work.
2. Observe the provisions for your own protection and for the protection of your co-workers.
3. Report unsafe working conditions or violations of the license or registration conditions or regulations to ADH.

REPORTS OF YOUR RADIATION EXPOSURE HISTORY

1. The ADH regulations specify the occupational limits for radiation exposure including concentrations of radioactive material in air and water. These regulations require your employer to give you a written report if you receive exposure in excess of any applicable limit. The limits on your exposure are contained in RH-1200, RH-1206, and RH-1207. While these are the maximum allowable limits, your employer should keep your radiation exposure below those limits as is reasonably achievable.
2. If you work where personnel monitoring is required and request information on your radiation exposures,
 - a. your employer must advise you annually of your exposure to radiation, and
 - b. upon termination of employment, your employer must give you a written report of your radiation exposures.
 - c. A report of any exposure in excess of a limit must be reported to you.

INSPECTIONS: All licensed or registered activities are subject to inspection by the ADH.

INQUIRIES

Direct all inquiries on matters outlined above to: ADH, Radiation Control Section, 4815 West Markham Street, Slot 30, Little Rock, Arkansas, 72205-3867 or to (501)661-2301. For emergencies, call (800) 633-1735.

POSTING REQUIREMENT: In accordance with RH-2802, copies of this notice must be posted in every establishment where employees are engaged in activities licensed or registered by the ADH. Posting must permit employees working in or frequenting any portion of a restricted area to observe a copy on the way to or from their place of employment.

Appendix I to Section 3
Form X

3-351

Revised 10/01/12

APPENDIX X

ATTACHMENT A

Radiation Exposure Form **Completed by:** _____ **Date:** _____

- I. This form should be completed for all exposures greater than 8,000 mGy.
- II. A copy of the form should be retained by the Responsible Physician for monitoring of dose and follow-up care.
- III. A copy of this form must be submitted to the Radiation Safety Officer for all exposures greater than 8,000 mGy.

Patient Name: _____

Last four of SS# or Medical Record #: _____

DOB: _____ Male / Female Pregnant: YES NO

Provider: _____ Procedure Room: _____

Date of Procedure: _____ Procedure: _____

Height: _____ Weight: _____

Total Fluoro Time (min): _____ Cumulative Dose (mGy) _____

Patient Follow Up (8,000-14,999 mGy)

Completed by: _____ **Date:** _____

Completed by: _____ **Date:** _____

10-14 days – Telephone appt. Date: Skin Effects: YES NO

28-32 days – Telephone appt. Date: Skin Effects: YES NO

If skin effects at 28-32 days, dermatology consult within 7 days of call. YES NO

Comments:

RSO Review: _____ Date: _____

Documentation Complete: YES NO

Patient Follow Up (> 15,000 mGy)

- **Immediately Notify the RSO, Responsible Physician, IR Manager, Radiology Technical Director, Home Service Line Director, Imaging Service Line Director, Chief Clinical Officer, Patient Safety Office and Risk Management.**
- **Document follow up on ATTACHMENT F (15,000 mGy Radiation Exposure Form)**

ATTACHMENT B

15,000 mGy Radiation Exposure Form **Completed by:** _____ **Date:** _____

- I. The Joint Commission has identified prolonged fluoroscopy with a cumulative dose equal to or greater than 15,000 mGy to a single field as a reviewable sentinel event.
- II. This form must be completed for all exposures greater than 15,000 mGy.
- III. A copy of this form must be immediately submitted to the Radiation Safety Officer. In addition the Responsible Physician, IR Manager, Radiology Technical Director, Home Service Line Director, Imaging Service Line Director, Chief Clinical Officer, Patient Safety Office and Risk Management must be notified. A copy of this form should be retained by the Responsible Physician for monitoring of dose and follow-up care.

Patient Name: _____ Last four of SS# or Medical Record: _____

Immediate Notification

Initials

Date

Radiation Safety Officer (RSO)	_____	_____
IR Manager	_____	_____
Radiology Technical Director	_____	_____
Home Service Line Director	_____	_____
Imaging Service Line Director	_____	_____
Chief Clinical Officer	_____	_____
Patient Safety Office	_____	_____
Risk Management	_____	_____

Patient Follow Up (15,000 mGy)

Completed by: _____ Date: _____

Completed by: _____ Date: _____

Completed by: _____ Date: _____

Day of Procedure:

- Provide discharge instructions for post radiation exposure
- Patient education to include self-examination for skin erythema and reporting of any radiation effects to physician.

10-14 Days – Telephone appointment Date: _____ Skin Effects: YES NO

28-32 Days – Clinic appointment Date: _____ Skin Effects: YES NO

35-40 Days – Dermatology consult if erythema present at 28-32 day clinic appointment.

Date: _____ Skin Effects: YES NO

Comments:

RSO Review: _____ Date: _____

Documentation Complete: YES NO